United States
Department of
Agriculture

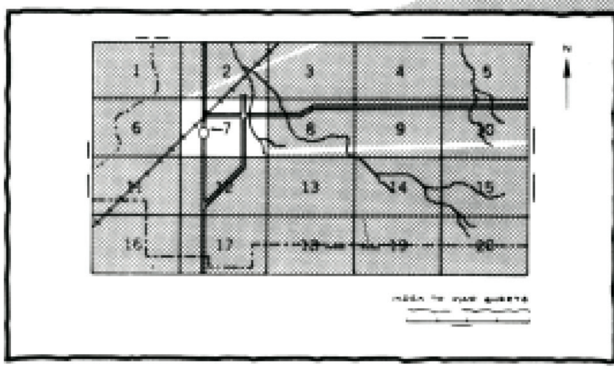
Soil
Conservation
Service

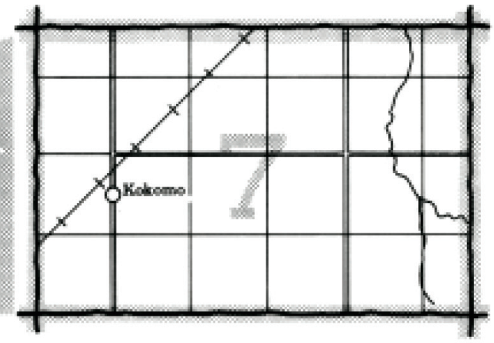
In cooperation with the
Kansas Agricultural
Experiment Station

Soil Survey of Kiowa County, Kansas

HOW TO USE

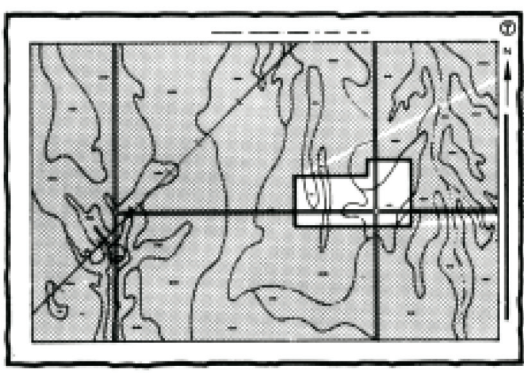
1. Locate your area of interest on the ''Index to Map Sheets''

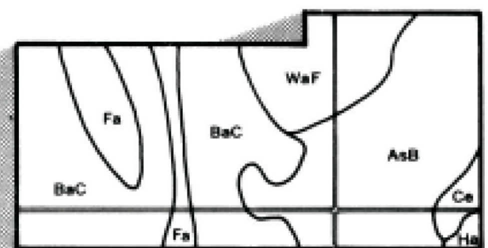




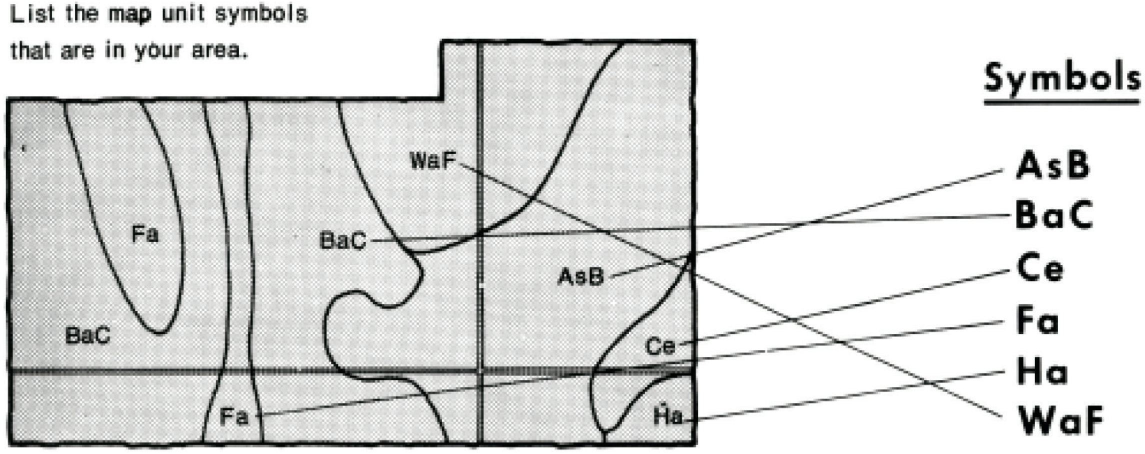
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



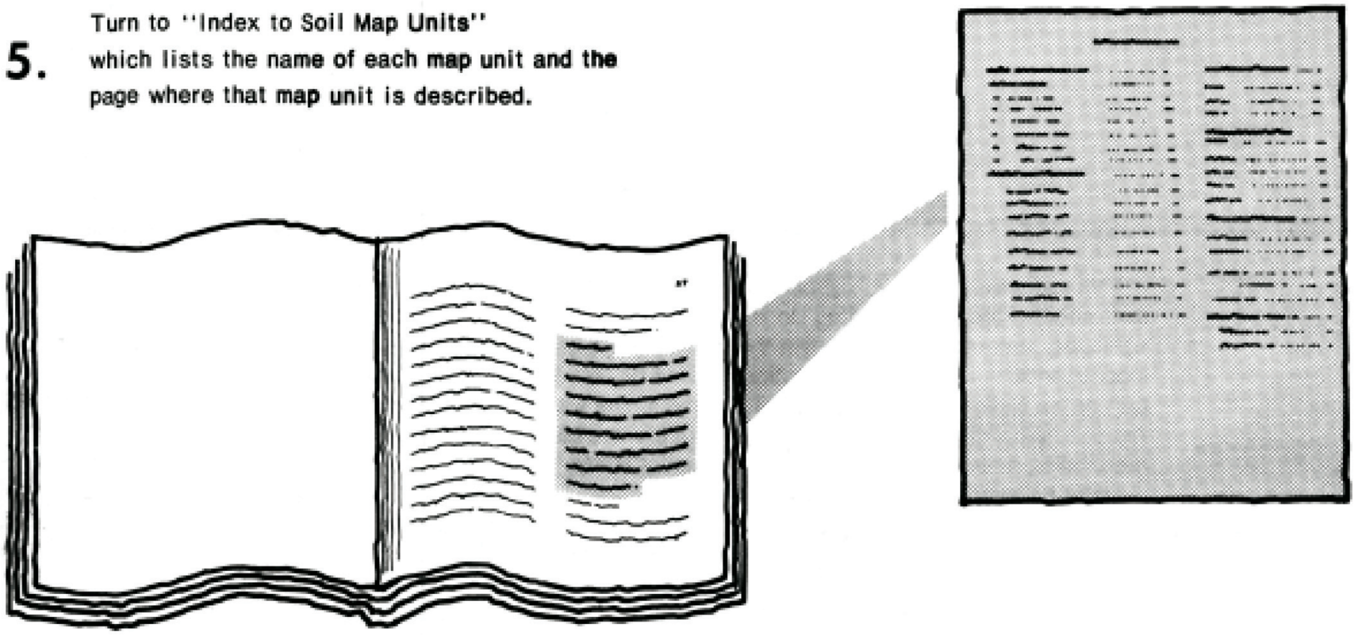


4. List the map unit symbols that are in your area.

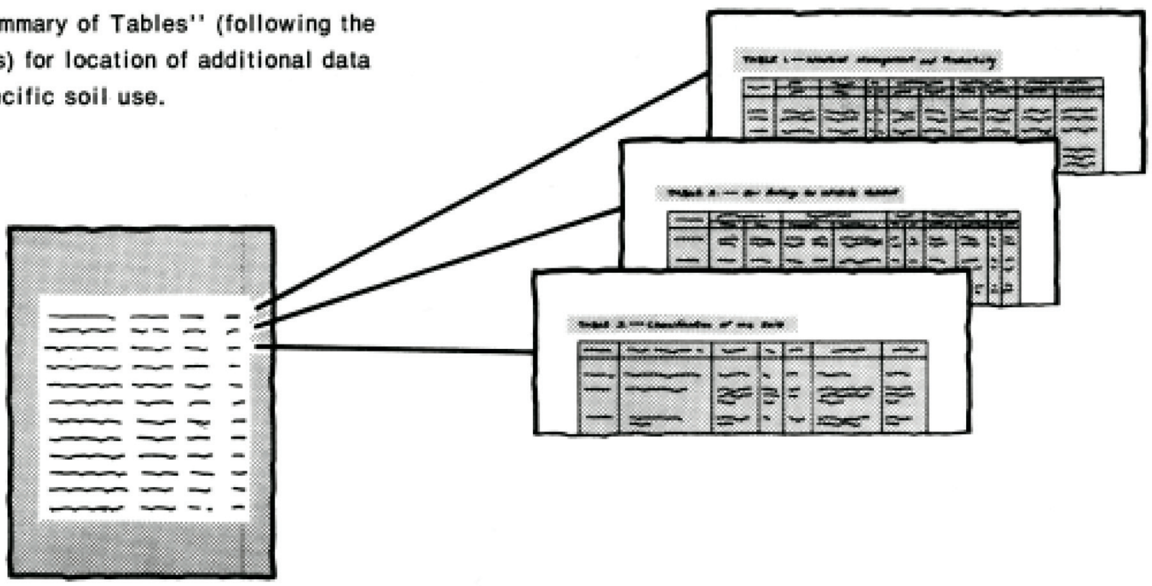


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed during the period 1979-83. Soil names and descriptions were approved in 1983. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1983. This survey was made cooperatively by the Soil Conservation Service and the Kansas Agricultural Experiment Station. It is part of the technical assistance furnished to the Kiowa County Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Owens and Dale soils in the valley of Medicine Lodge River.

Contents

Soil Series

Issued June 1986

Index to Map Units

Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Kiowa County, Kansas. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

John W. Tippie

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Soil Survey of
Kiowa County, Kansas

By Bruce R. Hoffman, Robert K. Glover,
and William E. Roth, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service,
in cooperation with
the Kansas Agricultural Experiment Station

KIOWA COUNTY is in the south-central part of Kansas (fig. 1). It has a total area of 462,573 acres, or about 700 square miles. In 1981, the population was 4,029. Greensburg, the county seat, has a population of 1,968. The county was organized in 1896 from parts of Edwards and Comanche Counties. It was named for the Kiowa Indian Tribe.

The economy of Kiowa County is based primarily on farming, ranching, oil and gas production, and related enterprises. In 1978, about 258,000 acres was cropland and 196,000 acres was range (*8*). About 44,200 acres of the cropland was irrigated. Wheat and grain sorghum are the principal crops.

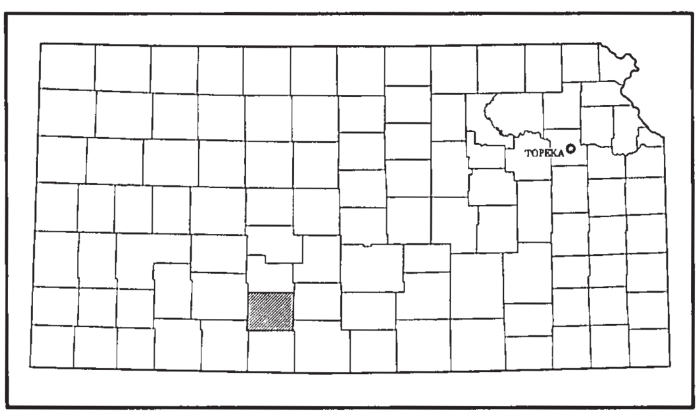

Figure 1.—Location of Kiowa County in Kansas.

General Nature of the County

This section gives general information concerning the county. It describes climate; physiography, drainage, and relief; water supply; and natural resources.

Climate

Prepared by L. Dean Bark, climatologist, Kansas Agricultural Experiment Station, Manhattan, Kansas.

The climate of Kiowa County is typical continental, as can be expected of a location in the interior of a large landmass in the middle latitudes. This climate is characterized by large daily and annual variations in temperature. Winter is cold because of frequent outbreaks of polar air; however, the cold temperatures prevail only from December through February. Warm summer temperatures prevail for about 6 months every year. They provide a long growing season for the crops grown in the county. Spring and fall are relatively short.

Kiowa County is generally to the west of the flow of moisture-laden air from the Gulf of Mexico. It is also to the east of the strong rain-shadow effects of the Rocky Mountains. The net result is an annual amount of precipitation that is marginal for continuous cropping. Precipitation is in the form of showers and thunderstroms that can be extremely heavy at times. Winds are relatively high in this region and can cause significant soil loss and crop damage in the drier years.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Greensburg in the period 1951 to 1976. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 34.1 degrees F, and the average daily minimum temperature is 21.6 degrees. The lowest temperature on record, which occurred at Greensburg on January 7 and 12, 1912, is −20 degrees. In summer the average temperature is 78.1 degrees, and the average daily maximum temperature is 91.5 degrees. The highest recorded temperature, which occurred at Greensburg on August 12 and 13, 1936, is 113 degrees.

The total annual precipitation is 22.55 inches. Of this, 16.4 inches, or 73 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 10.58 inches. The heaviest 1-day rainfall during the period of record was 4.63 inches at Greensburg on June 1, 1955.

Severe windstorms and occasional tornadoes accompany well developed thunderstorms in the county, but they are infrequent and of local extent. Losses from hail are a more severe weather hazard, but they are not so great as the losses in counties to the west of Kiowa County.

The average seasonal snowfall is 18.4 inches. The highest recorded seasonal snowfall was 52.2 inches, which occurred during the winter of 1911-12. On the average, 17 days of the year have at least 1 inch of snow on the ground. The snow cover rarely lasts more than 7 days in succession.

The sun shines 75 percent of the time possible in summer and 64 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 15.8 miles per hour, in March. The average annual windspeed is 14.0 miles per hour.

Physiography, Drainage, and Relief

The northern part of Kiowa County is in the Great Bend Sand Plains major land resource area, and the southern part is in the Central Rolling Red Plains (*3*). The northern third of the county is characterized by sandhills and has a typical sand-dune topography. Bordering the sandhills on the south are upland plains. These plains are in an east-west belt, about 2 to 8 miles wide, that extends across the central part of the county. This belt is characterized by gentle to moderate slopes and some nearly level areas. The southern part of the county has been deeply dissected by stream erosion. As a result, the topography is rugged, as is indicated by a local relief of about 300 feet (*5*).

The northern half of the county is in the upper Arkansas drainage basin and is drained by Rattlesnake Creek and its tributaries. The southeastern and south-central parts of the county are in the lower Arkansas drainage basin and are drained by the Medicine Lodge River and Mule Creek. The southwestern part is in the Cimarron drainage basin and is drained by tributaries of Sand Creek (*5*). Elevation ranges from 2,440 feet above sea level in an area along the western county line to 1,740 feet in an area along the Medicine Lodge River and the Barber County line.

Water Supply

Wells are the major source of water in the county. Water in sufficient quantity for irrigation is available in the northern part of the county. The acreage of irrigated land increased from 278 acres in 1939 to about 44,200 acres in 1978. Nearly all of this increase is the result of increased use of center-pivot irrigation systems during the last 20 years. Domestic and livestock water generally is obtained from wells. In the southeastern part of the county, where shale and sandstone crop out, ponds furnish livestock water.

Natural Resources

Soil is the most important natural resource in the county. It provides a growing medium for cash crops and for the grasses grazed by livestock. Other natural resources are water, oil, gas, and sand and gravel. The sand and gravel are used for road surfacing.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The descriptions and names of the soils identified on the general soil map of this county do not fully agree with those of the soils identified on the maps of adjacent counties. Differences result from a better knowledge of soils, modification of series concepts, a higher or lower intensity of mapping, and variations in the extent of the soils in the counties.

Soil Association Descriptions

1. Pratt-Tivoli Association

Deep, undulating to hilly, well drained and excessively drained soils that have a sandy subsoil; on uplands

This association is on knolls, hills, and undulating uplands. Slope ranges from 1 to 30 percent.

This association makes up about 14 percent of the county. It is about 68 percent Pratt soils and 32 percent Tivoli soils (fig. 2).

The well drained, undulating and rolling Pratt soils formed in sandy eolian deposits on side slopes. Typically, the surface layer is brown loamy fine sand about 12 inches thick. The subsoil is light yellowish brown, very friable loamy fine sand about 24 inches thick. The substratum to a depth of about 60 inches is light yellowish brown loamy fine sand.

The excessively drained, rolling and hilly Tivoli soils formed in sandy eolian deposits on hills, the crest of knolls, and the upper side slopes. Typically, the surface layer is brown fine sand about 6 inches thick. The substratum to a depth of about 60 inches is light yellowish brown fine sand.

About 75 percent of this association is used as range. The rest, mainly the less sloping areas of the Pratt soils, is used for dryland or irrigated crops. Maintaining the growth and vigor of desirable grasses and forbs is the main concern in managing range. Controlling soil blowing, maintaining fertility, and conserving moisture are the main concerns in managing the cultivated areas.

2. Pratt-Attica Association

Deep, undulating and rolling, well drained soils that have a sandy or loamy subsoil; on uplands

This association is on knolls and undulating uplands. Slope ranges from 1 to 15 percent.

This association makes up about 20 percent of the county. It is about 62 percent Pratt soils, 28 percent Attica and similar soils, and 10 percent minor soils (fig. 3).

The undulating and rolling Pratt soils formed in sandy eolian deposits on ridges and the upper side slopes. Typically, the surface layer is brown loamy fine sand about 12 inches thick. The subsoil is light yellowish brown, very friable loamy fine sand about 24 inches thick. The substratum to a depth of about 60 inches is light yellowish brown loamy fine sand.

The undulating Attica soils formed in loamy eolian deposits on the lower side slopes. Typically, the surface layer is pale brown loamy fine sand about 10 inches thick. The subsoil is friable fine sandy loam about 20 inches thick. The upper part is grayish brown, and the lower part is brown. The substratum to a depth of about 60 inches is brown fine sandy loam.

The minor soils in this association are the somewhat poorly drained Carwile soils in depressions.

Nearly all of this association is used for dryland and irrigated crops. Controlling soil blowing, maintaining fertility, and conserving moisture are the main concerns in managing the cultivated areas.

3. Farnum-Naron Association

Deep, nearly level and gently sloping, well drained soils that have a loamy subsoil; on uplands

This association is on upland ridges and side slopes. Slope ranges from 0 to 3 percent.

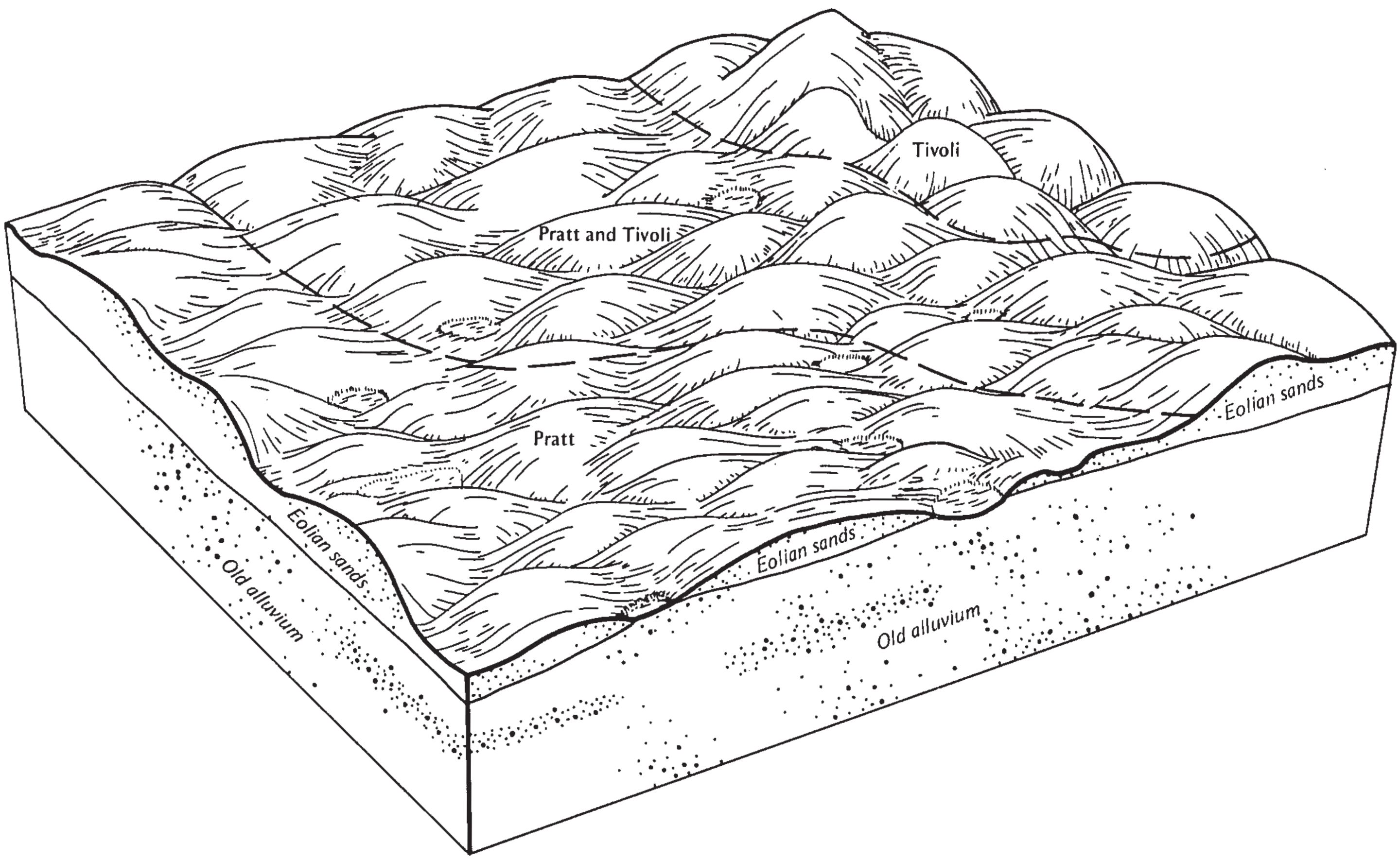

Figure 2.—Typical pattern of soils and underlying material in the Pratt-Tivoli association.

This association makes up about 9 percent of the county. It is about 47 percent Farnum soils, 43 percent Naron and similar soils, and 10 percent minor soils.

The nearly level and gently sloping Farnum soils formed in loamy old alluvium on flats, ridges, and side slopes. Typically, the surface layer is dark grayish brown and very dark grayish brown loam about 11 inches thick. The subsoil is firm clay loam about 40 inches thick. The upper part is dark grayish brown, the next part is brown, and the lower part is light brown. The substratum to a depth of about 60 inches is light brown, calcareous clay loam.

The nearly level and undulating Naron soils formed in loamy eolian deposits on low ridges. Typically, the surface layer is brown fine sandy loam about 10 inches thick. The subsoil is brown, friable sandy clay loam about 38 inches thick. The substratum to a depth of about 60 inches is yellowish brown fine sandy loam.

The minor soils in this association are the Carwile, Case, and Clark soils. The somewhat poorly drained Carwile soils are in depressions. The moderately sloping, calcareous Case soils are on side slopes. The gently sloping and moderately sloping, calcareous Clark soils also are on side slopes.

Nearly all of this association is used for dryland and irrigated crops. Controlling soil blowing and water erosion, conserving moisture, and maintaining tilth and fertility are concerns in managing the cultivated areas.

4. Harney Association

Deep, nearly level and gently sloping, well drained soils that have a silty subsoil; on uplands

This association is on broad ridgetops and side slopes that are drained by intermittent streams. In places it is cut by entrenched drainageways. Slope ranges from 0 to 3 percent.

This association makes up about 16 percent of the county. It is about 86 percent Harney and similar soils and 14 percent minor soils.

The Harney soils formed in loess. Typically, the surface layer is grayish brown silt loam about 5 inches thick. The subsurface layer is dark grayish brown, friable silty clay loam about 9 inches thick. The subsoil is silty clay loam about 36 inches thick. The upper part is grayish brown and very firm; the next part is brown, firm, and calcareous; and the lower part is yellowish brown, friable, and calcareous. The substratum to a depth of about 60 inches is yellowish brown, calcareous silt loam.

The minor soils in this association are the Coly, Ness, Tobin, and Uly soils. The moderately sloping and strongly sloping, calcareous Coly soils are on the lower side slopes. The poorly drained Ness soils are in upland depressions. Tobin soils are on flood plains. The moderately sloping Uly soils are on the lower side slopes.

Nearly all of this association is used for cultivated crops. Controlling water erosion, maintaining tilth and fertility, and conserving moisture are concerns in managing the cultivated areas.

5. Coly-Harney-Holdrege Association

Deep, gently sloping to steep, well drained soils that have a silty subsoil; on uplands

This association is on narrow ridgetops and side slopes that are drained by intermittent streams. Slope ranges from 1 to 40 percent.

This association makes up about 17 percent of the county. It is about 35 percent Coly soils, 27 percent Harney soils, 20 percent Holdrege soils, and 18 percent minor soils (fig. 4).

The moderately sloping to steep Coly soils formed in loess on side slopes. Typically, the surface layer is pale brown, calcareous silt loam about 5 inches thick. The next layer is very pale brown, friable, calcareous silt loam about 7 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The gently sloping Harney soils formed in loess on ridges. Typically, the surface layer is grayish brown silt loam about 5 inches thick. The subsurface layer is dark grayish brown, friable silty clay loam about 9 inches thick. The subsoil is silty clay loam about 36 inches thick. The upper part is grayish brown and very firm; the next part is brown, firm, and calcareous; and the lower part is

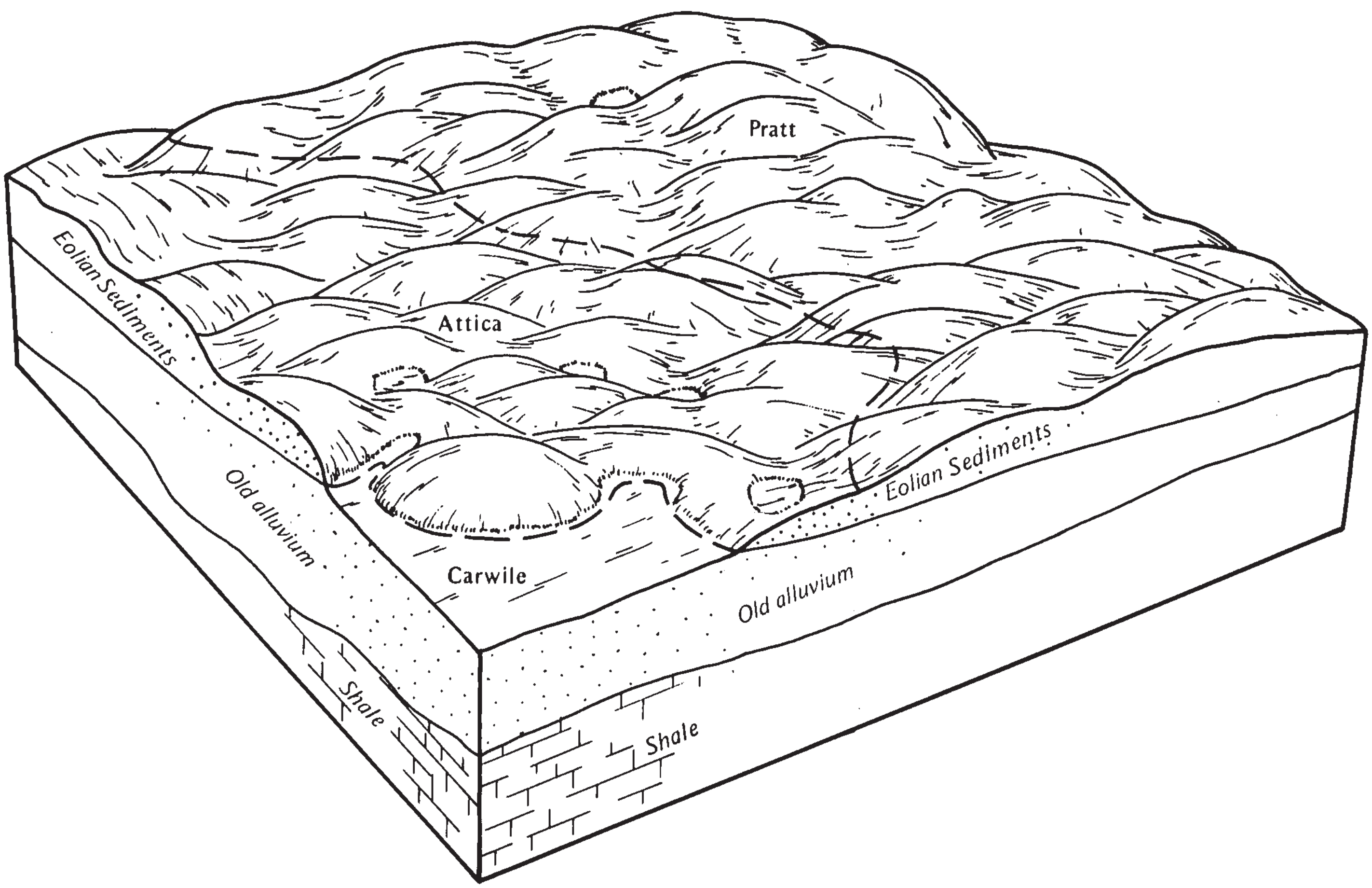

Figure 3.—Typical pattern of soils and underlying material in the Pratt-Attica association.

yellowish brown, friable, and calcareous. The substratum to a depth of about 60 inches is yellowish brown, calcareous silt loam.

The gently sloping Holdrege soils formed in loess on ridges. Typically, the surface layer is grayish brown silt loam about 5 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 5 inches thick. The subsoil is silty clay loam about 22 inches thick. The upper part is dark grayish brown and friable; the next part is brown and firm; and the lower part is pale brown, friable, and calcareous. The substratum to a depth of about 60 inches is light yellowish brown, calcareous silt loam.

The minor soils in this association are the Case, Clark, Tobin, and Uly soils. The calcareous Case and Clark soils have a loamy subsoil. They are on the lower side slopes. Tobin soils are on flood plains. The moderately sloping Uly soils are on the lower side slopes.

Most of this association is used for cultivated crops. The steeper areas of Coly soils are used as range. Controlling erosion, maintaining tilth and fertility, and conserving moisture are concerns in managing the cultivated areas. Maintaining the growth and vigor of desirable grasses and forbs is the main concern in managing range.

6. Case-Shellabarger-Albion Association

Deep, gently sloping to strongly sloping, well drained and somewhat excessively drained soils that have a loamy subsoil; on uplands

This association is on narrow ridges and side slopes that are drained by intermittent streams. Slope ranges from 1 to 15 percent.

This association makes up about 14 percent of the county. It is about 52 percent Case and similar soils, 13 percent Shellabarger soils, 12 percent Albion soils, and 23 percent minor soils.

The well drained, moderately sloping and strongly sloping Case soils formed in calcareous, loamy old alluvium on side slopes. Typically, the surface layer is grayish brown, calcareous clay loam about 6 inches

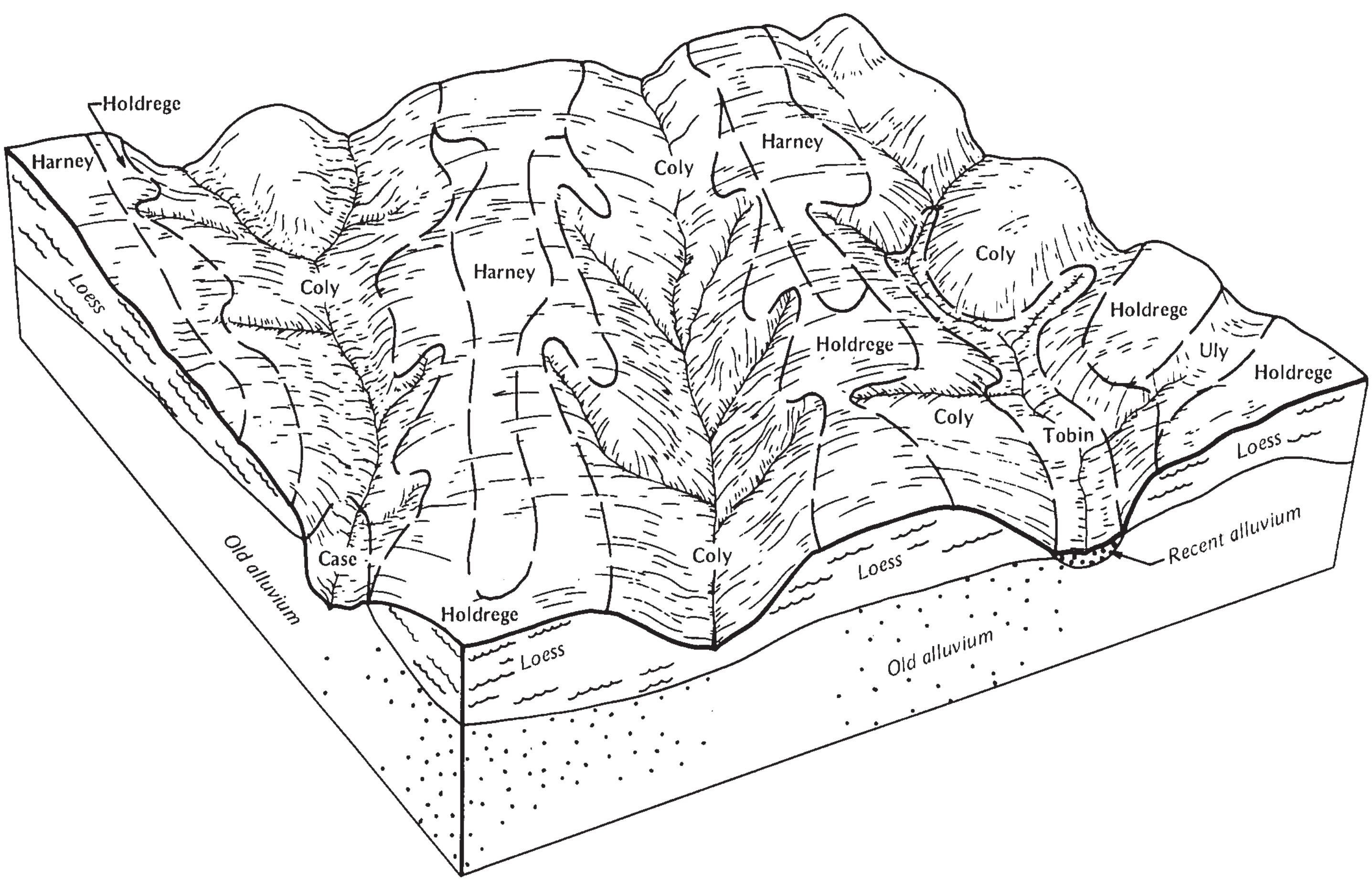

Figure 4.—Typical pattern of soils and underlying material in the Coly-Harney-Holdrege association.

thick. The subsoil is calcareous clay loam about 20 inches thick. The upper part is light brownish gray and friable, and the lower part is mottled, very pale brown, mottled and firm. The substratum to a depth of about 60 inches is very pale brown, calcareous clay loam.

The well drained, moderately sloping and strongly sloping Shellabarger soils formed in old alluvium on ridges and side slopes. Typically, the surface layer is reddish brown loam about 11 inches thick. The subsoil is about 33 inches thick. It is reddish brown, friable sandy clay loam in the upper part and brown, very friable sandy loam in the lower part. The substratum to a depth of about 60 inches is light brown sandy loam.

The somewhat excessively drained, gently sloping to strongly sloping Albion soils formed in loamy old alluvium over sand. They are on ridges and side slopes. Typically, the surface layer is grayish brown sandy loam about 11 inches thick. The subsoil is brown, friable sandy loam about 13 inches thick. The substratum to a depth of about 60 inches is light yellowish brown sand.

The minor soils in this association are the Canadian, Canlon, Dale, Plevna, and Waldeck soils. Canadian and Dale soils are subject to rare flooding and are on stream terraces. The shallow Canlon soils are on side slopes. The poorly drained Plevna soils and the somewhat poorly drained Waldeck soils are on flood plains.

Nearly all of this association is used as range. Maintaining the growth and vigor of desirable grasses and forbs is the main concern in managing range.

7. Owens-Lancaster-Quinlan Association

Shallow and moderately deep, moderately sloping to steep, well drained soils that have a clayey or loamy subsoil; on uplands

This association is on narrow ridges and side slopes that are drained by intermittent streams. Slope ranges from 4 to 25 percent.

This association makes up about 10 percent of the county. It is about 41 percent Owens soils, 14 percent Lancaster and similar soils, 9 percent Quinlan and similar soils, and 36 percent minor soils.

The shallow, strongly sloping to steep Owens soils formed in material weathered from shale. Typically, the surface layer is grayish brown, calcareous clay about 6 inches thick. The subsoil is grayish brown, very firm, calcareous clay about 9 inches thick. Gray, clayey shale bedrock is at a depth of about 15 inches.

The moderately deep, moderately sloping and strongly sloping Lancaster soils formed in material weathered from sandstone. Typically, the surface layer is grayish brown loam about 13 inches thick. The subsoil is pale brown, friable loam about 10 inches thick. Very pale brown and yellow, weathered sandstone bedrock is at a depth of about 23 inches.

The shallow, strongly sloping to steep Quinlan soils formed in material weathered from sandstone. Typically, the surface layer is reddish brown, calcareous loam about 7 inches thick. The subsoil is reddish brown, friable, calcareous loam about 8 inches thick. Calcareous sandstone bedrock is at a depth of about 15 inches.

The minor soils in this association are the deep Case, Clark, Dale, Lincoln, New Cambria, and Waldeck soils. The calcareous Case and Clark soils are on ridges. The well drained Dale soils and the moderately well drained New Cambria soils are on stream terraces. The somewhat excessively drained Lincoln soils and the somewhat poorly drained Waldeck soils are on flood plains.

Most of this association is used as range. The areas used for cultivated crops are mainly those of the minor soils on bottom land. Maintaining the growth and vigor of desirable grasses and forbs is the main concern in managing range.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Pratt loamy fine sand, undulating, is one of several phases in the Pratt series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Case-Canlon complex, 7 to 20 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

The descriptions and names of the soils identified on the detailed soil maps of this county do not fully agree with those of the soils identified on the maps of adjacent counties. Differences result from a better knowledge of soils, modification of series concepts, a higher or low intensity of mapping, and variations in the extent of the soils in the counties.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

An—Albion sandy loam, 1 to 4 percent slopes. This deep, gently sloping, somewhat excessively drained soil is on upland ridges and side slopes. Individual areas are irregular in shape and range from 20 to 500 acres in size.

Typically, the surface layer is grayish brown sandy loam about 11 inches thick. The subsoil is brown, friable sandy loam about 13 inches thick. The substratum to a depth of about 60 inches is light yellowish brown sand.

Included with this soil in mapping are small areas of the calcareous Clark soils and the well drained Shellabarger soils. These soils are on the upper side slopes or on knolls. They make up about 15 percent of the map unit.

Permeability is moderately rapid in the Albion soil, and runoff is slow. Available water capacity and natural fertility are low. The surface layer is slightly acid and friable, and tilth is good.

Most areas are used as range. The rest are used for cultivated crops. Droughtiness is a limitation affecting the use of this soil as range. Water erosion and soil blowing are hazards if the range is overgrazed. They can be controlled by maintaining an adequate plant cover.

This soil is moderately well suited to wheat and sorghum. Because of the low available water capacity, it is better suited to small grain than to grain sorghum. Water erosion and soil blowing are hazards if cultivated crops are grown. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and soil blowing and conserve moisture.

This soil is only moderately well suited to irrigation because it is droughty. Minimizing tillage, leaving crop residue on the surface, and applying a small amount of water at frequent intervals help to control water erosion and soil blowing and conserve water.

This soil is well suited to dwellings. It is poorly suited to onsite waste disposal. The sandy substratum does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity may result in the pollution of shallow ground water. Areas where the depth to sand is more than 40 inches are suitable as septic tank absorption fields. This soil is a probable source of sand and gravel.

The land capability classification is IIIe, dryland and irrigated. The range site is Sandy.

As—Albion-Shellabarger sandy loams, 4 to 15 percent slopes. These deep, moderately sloping and strongly sloping soils are on uplands. The somewhat excessively drained Albion soil is on side slopes. The well drained Shellabarger soil is on ridges. Individual areas are irregular in shape and range from 20 to several hundred acres in size. They are about 50 percent Albion soil and 30 percent Shellabarger soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Albion soil has a surface layer of grayish brown sandy loam about 11 inches thick. The subsoil is brown, friable sandy loam about 13 inches thick. The substratum to a depth of about 60 inches is light yellowish brown sand.

Typically, the Shellabarger soil has a surface layer of reddish brown sandy loam about 12 inches thick. The subsoil is friable sandy clay loam about 28 inches thick. The upper part is reddish brown, and the lower part is light brown. The substratum to a depth of about 60 inches is light brown sandy loam. In some areas the subsoil is clay loam.

Included with these soils in mapping are small areas of Case and Lincoln soils and soils that are gravelly loamy sand throughout. Case soils are calcareous throughout. They are on narrow ridges. The sandy Lincoln soils are on flood plains. Included soils make up about 15 percent of the map unit.

Permeability is moderately rapid in the Albion soil and moderate in the Shellabarger soil. Available water capacity is low in the Albion soil and moderate in the Shellabarger soil. Runoff is slow on the Albion soil and medium on the Shellabarger soil.

Nearly all areas are used as range. Because of a severe hazard of water erosion, these soils are generally unsuited to cultivated crops. They are better suited to range. Droughtiness is a concern in managing the Albion soil as range. Water erosion and soil blowing are hazards on both soils if the range is overgrazed. They can be controlled by maintaining an adequate plant cover.

These soils are moderately well suited to dwellings. Because of the slope, some land shaping commonly is needed.

The Albion soil is generally unsuited to onsite waste disposal. The sandy substratum does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity may result in the pollution of shallow ground water. Seepage and slope are limitations on sites for sewage lagoons. Because it is deeper over the underlying sandy material, the Shellabarger soil is a better site for waste disposal systems than the Albion soil. The slope, however, is a limitation. The less sloping areas can be selected as sites for septic tank absorption fields and sewage lagoons. Sealing the floor of the lagoon helps to control seepage. The Albion soil is a probable source of sand and gravel.

The land capability classification is VIe, dryland. The range site is Sandy.

At—Attica loamy fine sand, 1 to 4 percent slopes. This deep, undulating, well drained soil is on uplands. Individual areas are irregular in shape and range from 20 to 500 acres in size.

Typically, the surface layer is pale brown loamy fine sand about 10 inches thick. The subsoil is friable fine sandy loam about 20 inches thick. The upper part is grayish brown, and the lower part is brown. The substratum to a depth of about 60 inches is brown fine sandy loam. In some areas the subsoil is loamy fine sand or sandy clay loam.

Included with this soil in mapping are small areas of Carwile and Farnum soils. The somewhat poorly drained Carwile soils have a clayey subsoil and are in depressions. Farnum soils have a subsoil that is more clayey than that of the Attica soil. They are in the less sloping areas. Included soils make up about 10 percent of the map unit.

Permeability is moderately rapid in the Attica soil, and runoff is slow. Available water capacity is moderate, and natural fertility is low. The surface layer is slightly acid and very friable, and tilth is good.

Nearly all areas are used for cultivated crops. Some are irrigated. This soil is well suited to dryland wheat and sorghum. If cultivated crops are grown, soil blowing is a hazard. It can be controlled by stubble mulch tillage, wind stripcropping, and minimum tillage.

This soil is well suited to irrigation. Wheat, sorghum, alfalfa, corn, and soybeans are suitable irrigated crops. Minimizing tillage, leaving crop residue on the surface, and managing water efficiently help to control soil blowing and conserve water.

This soil is well suited to dwellings and septic tank absorption fields. It is generally unsuited to sewage lagoons because of seepage.

The land capability classification is IIIe, dryland and irrigated. The range site is Sandy.

Ax—Attica-Carwile complex, 0 to 4 percent slopes. These deep, nearly level and undulating soils are on uplands. The well drained Attica soil is on ridges. The somewhat poorly drained Carwile soil is in depressions. It is subject to ponding. Individual areas are irregular in shape and range from 20 to 500 acres in size. They are about 60 percent Attica soil and 30 percent Carwile soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Attica soil has a surface layer of pale brown loamy fine sand about 10 inches thick. The subsoil is friable fine sandy loam about 20 inches thick. The upper part is grayish brown, and the lower part is brown. The substratum to a depth of about 60 inches is brown fine sandy loam. In some areas the subsoil is loamy fine sand.

Typically, the Carwile soil has a surface layer of grayish brown fine sandy loam about 6 inches thick. The subsurface layer is gray, friable fine sandy loam about 9 inches thick. The subsoil is firm clay about 35 inches thick. The upper part is gray, and the lower part is light brownish gray. The substratum to a depth of about 60 inches is light brownish gray, mottled, calcareous clay.

Included with these soils in mapping are small areas of the well drained Farnum soils. These included soils have a clay loam subsoil. They are in the less sloping areas. They make up about 10 percent of the map unit.

Permeability is moderately rapid in the Attica soil and slow in the Carwile soil. Runoff is slow on the Attica soil and slow to ponded on the Carwile soil. Available water capacity is moderate in the Attica soil and high in the Carwile soil. Natural fertility is low in the Attica soil and medium in the Carwile soil. The shrink-swell potential is high in the subsoil of the Carwile soil. Tilth is good in both soils. The surface layer of the Attica soil is slightly acid, and that of the Carwile soil is medium acid.

Nearly all areas are used for cultivated crops. Some are irrigated. These soils are well suited to dryland wheat and sorghum. Soil blowing is a hazard if cultivated crops are grown. Also, wetness is a limitation in low areas of the Carwile soil. Stubble mulch tillage, wind stripcropping, and minimum tillage help to control soil blowing. In places ditches can improve surface drainage.

These soils are well suited to irrigation. Wheat, sorghum, alfalfa, corn, and soybeans are suitable irrigated crops. Alfalfa can be drowned in some low areas. Minimizing tillage, leaving crop residue on the surface, and managing water efficiently help to control soil blowing and conserve water.

The Attica soil is well suited to dwellings and septic tank absorption fields. It is generally unsuited to sewage lagoons because of seepage. The Carwile soil is poorly suited to dwellings and sewage disposal systems because of the ponding.

The land capability classification is IIIe, dryland and irrigated. The range site is Sandy.

Ca—Canadian fine sandy loam. This deep, nearly level, well drained soil is on stream terraces. It is subject to rare flooding. Areas are elongated and range from 10 to 200 acres in size.

Typically, the surface soil is grayish brown fine sandy loam about 14 inches thick. The subsoil is brown, friable fine sandy loam about 16 inches thick. The substratum to a depth of about 60 inches is yellowish brown fine sandy loam. In some areas the soil is loam throughout.

Included with this soil in mapping are small areas of the somewhat excessively drained Lincoln and somewhat poorly drained Waldeck soils on the slightly lower flood plains. These soils make up about 10 percent of the map unit.

Permeability is moderately rapid in the Canadian soil, and runoff is slow. Available water capacity is moderate. Natural fertility is medium. The surface layer is neutral and friable, and tilth is good.

Most areas are used as range. The rest are used for cultivated crops. Soil blowing is a hazard in unprotected areas used as range. It can be controlled by maintaining an adequate plant cover.

This soil is well suited to dryland wheat and sorghum. Soil blowing is a hazard if cultivated crops are grown. Stubble mulch tillage, wind stripcropping, and minimum tillage help to control soil blowing and conserve moisture.

This soil is well suited to irrigation. Wheat, sorghum, alfalfa, corn, and soybeans are suitable irrigated crops. Minimizing tillage, leaving crop residue on the surface, and managing water efficiently help to control soil blowing and conserve water. Land leveling improves water distribution.

This soil is poorly suited to dwellings and is moderately well suited to septic tank absorption fields. The flooding is a hazard affecting both uses. Dikes, levees, and other flood-control structures may be needed. The higher parts of the landscape can be selected as building sites. This soil is generally unsuited to sewage lagoons because of seepage.

The land capability classification is IIe, dryland and irrigated. The range site is Sandy Terrace.

Cc—Carwile fine sandy loam. This deep, nearly level, somewhat poorly drained soil is on slightly depressional uplands. It is subject to ponding. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is grayish brown fine sandy loam about 6 inches thick. The subsurface layer is gray, friable fine sandy loam about 9 inches thick. The subsoil is firm clay about 35 inches thick. The upper part is gray, and the lower part is light brownish gray. The substratum to a depth of about 60 inches is light brownish gray, mottled, calcareous clay.

Included with this soil in mapping are small areas of Farnum and Pratt soils. These well drained soils are in the higher areas or on mounds. They make up about 15 percent of the map unit.

Permeability is slow in the Carwile soil, and runoff is slow to ponded. Available water capacity is high. Natural fertility is medium. The surface layer is medium acid and very friable, and tilth is good. The shrink-swell potential is high in the subsoil.

Nearly all areas are used for cultivated crops. This soil is well suited to dryland wheat and sorghum. Excessive wetness is a limitation if cultivated crops are grown. Planting, harvesting, and tilling are delayed at times. In places ditches can improve surface drainage. Soil blowing is a hazard when the surface is dry and unprotected. Returning crop residue to the soil, wind stripcropping, and minimizing tillage help to control soil blowing and increase the rate of water infiltration.

This soil is well suited to irrigation. Wheat, sorghum, corn, and soybeans are the most suitable irrigated crops. Land leveling improves drainage and results in a uniform water distribution. Minimizing tillage, leaving crop residue on the surface, and managing water efficiently help to control soil blowing and conserve water.

This soil is poorly suited to dwellings because of the ponding. The sandy included soils on mounds are better sites for dwellings.

This soil generally is unsuitable as a septic tank absorption field because of the ponding and the slow permeability. If the ponding is controlled, sewage lagoons are a suitable alternative method of onsite waste disposal.

The land capability classification is IIw, dryland and irrigated. The range site is Sandy.

Ce—Case clay loam, 2 to 7 percent slopes. This deep, moderately sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is grayish brown, calcareous clay loam about 6 inches thick. The subsoil is calcareous clay loam about 20 inches thick. The upper part is light brownish gray and friable, and the lower part is very pale brown, mottled, and firm. The substratum to a depth of about 60 inches is very pale brown, calcareous clay loam. In some areas the surface layer is dark grayish brown and is 10 to 15 inches thick.

Included with this soil in mapping are long, narrow areas of loamy alluvial soils that are dark and calcareous. These soils are along drainageways. They make up about 5 percent of the map unit.

Permeability is moderate in the Case soil, and runoff is medium. Available water capacity is high. Natural fertility is low. The surface layer is friable, and tilth is good. The soil is mildly alkaline or moderately alkaline throughout. The shrink-swell potential is moderate in the subsoil.

Nearly all areas are used for cultivated crops. This soil is moderately well suited to wheat and sorghum. Water erosion is a hazard if cultivated crops are grown. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and conserve moisture. Sorghum is subject to iron chlorosis.

This soil is moderately well suited to dwellings, septic tank absorption fields, and sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations and backfilling with suitable coarse material, however, help to prevent the structural damage caused by shrinking and swelling. The moderate permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome, however, by enlarging the field. Seepage and slope are limitations on sites for sewage lagoons. Sealing the lagoon helps to control seepage. Some land shaping commonly is needed to overcome the slope.

The land capability classification is IVe, dryland. The range site is Limy Upland.

Cf—Case clay loam, 7 to 15 percent slopes. This deep, strongly sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape or long and narrow and range from 10 to 400 acres in size.

Typically, the surface layer is grayish brown, calcareous clay loam about 6 inches thick. The subsoil is light brownish gray, friable, calcareous clay loam about 19 inches thick. The substratum to a depth of about 60 inches is light gray, calcareous clay loam. In some areas the surface layer is dark grayish brown and is 10 to 15 inches thick.

Included with this soil in mapping are small areas of Canlon soils and long, narrow areas of loamy alluvial soils that are dark and calcareous. The alluvial soils are along drainageways. The shallow Canlon soils are on the lower side slopes or on knobs. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Case soil, and runoff is rapid. Available water capacity is high. Natural fertility is low. The soil is mildly alkaline or moderately alkaline throughout. The shrink-swell potential is moderate in the subsoil.

Nearly all areas are used as range. Because of a severe hazard of water erosion, this soil is generally unsuited to cultivated crops. It is better suited to range. Water erosion and soil blowing are hazards in overgrazed areas. Gullies form along some cattle trails.

Maintaining an adequate plant cover helps to control water erosion and soil blowing. Fencing and other means of controlling livestock traffic patterns help to prevent gullying and give gullies time to revegetate.

This soil is moderately well suited to dwellings. The shrink-swell potential and the slope are limitations. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the structural damage caused by shrinking and swelling. Some land shaping commonly is needed to overcome the slope.

This soil is moderately well suited to septic tank absorption fields and is poorly suited to sewage lagoons. The slope is the main limitation. Also, the moderate permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome, however, by enlarging the field. Because of the slope, lateral lines should be installed on the contour.

The land capability classification is VIe, dryland. The range site is Limy Upland.

Cg—Case-Canlon complex, 7 to 20 percent slopes. These well drained, strongly sloping soils are on side slopes in the uplands. The deep Case soil is lower on the landscape than the shallow Canlon soil. Individual areas are irregular in shape and range from 20 to 500 acres in size. They are about 60 percent Case soil and 25 percent Canlon soil. These two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Case soil has a surface layer of grayish brown, calcareous clay loam about 6 inches thick. The subsoil is light brownish gray, friable, calcareous clay loam about 19 inches thick. The substratum to a depth of about 60 inches is light gray, calcareous clay loam. In some areas the depth to caliche bedrock is less than 40 inches.

Typically, the Canlon soil has a surface layer of light brownish gray, calcareous loam about 5 inches thick. The next layer also is light brownish gray, calcareous loam about 5 inches thick. The substratum is light gray, calcareous loam. Hard caliche bedrock is at a depth of about 14 inches (fig. 5).

Included with these soils in mapping are small areas of rock outcrop and loamy alluvial soils that are dark and calcareous. The rock outcrop occurs as barren areas of caliche on knobs or on ledges. The alluvial soils are occasionally flooded and are on bottom land along drainageways. Included areas make up about 15 percent of the map unit.

Permeability is moderate in the Case and Canlon soils, and runoff is rapid. Available water capacity is high in the Case soil and very low in the Canlon soil. The shrink-swell potential is moderate in the subsoil of the Case soil. Root penetration is restricted by the caliche at a depth of about 14 inches in the Canlon soil. Both soils are mildly alkaline or moderately alkaline throughout.

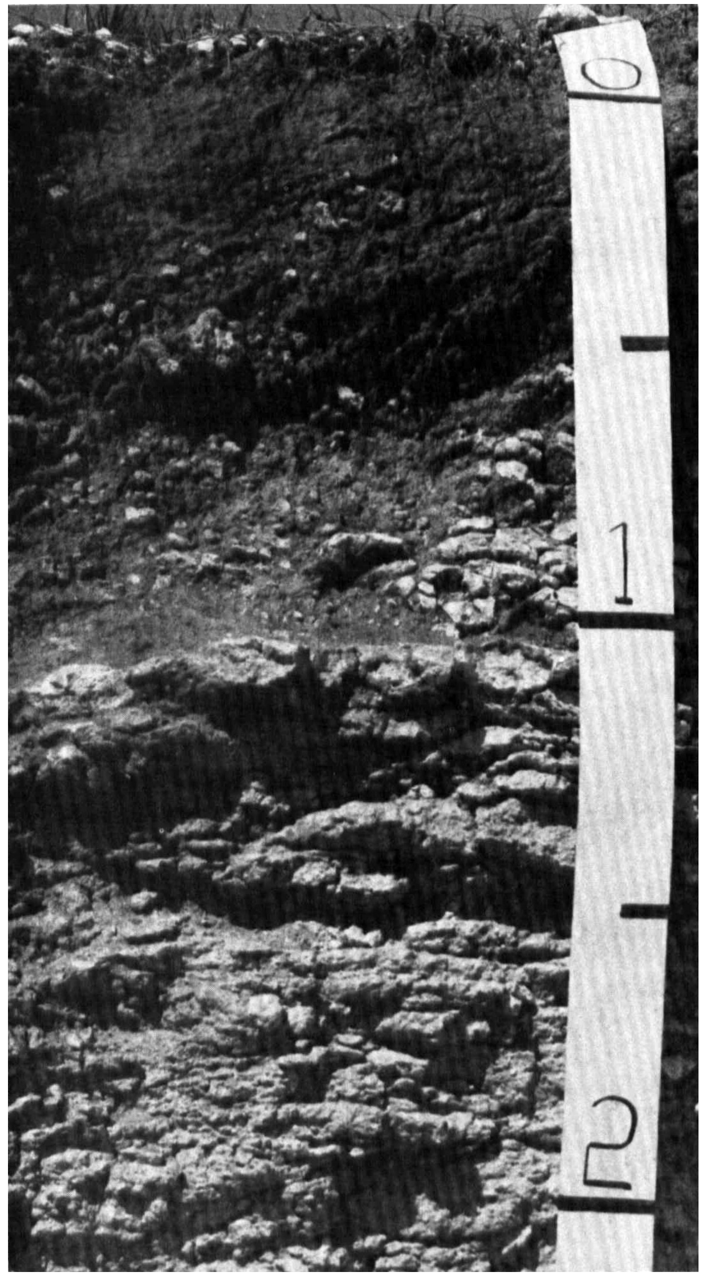

Figure 5.—Typical profile of Canlon loam, which is shallow over caliche. Depth is shown in feet.

Nearly all areas are used as range (fig. 6). Because of a severe hazard of water erosion, these soils are generally unsuited to cropland. They are better suited to range. Droughtiness is a concern in managing the Canlon soil as range. Water erosion and soil blowing are hazards on both soils if the range is overgrazed. Gullies form along some cattle trails. Maintaining an adequate plant cover helps to control water erosion and soil blowing. Fencing and other means of controlling livestock traffic patterns help to prevent gullying and give gullies time to revegetate.

The Case soil is moderately well suited to dwellings and septic tank absorption fields. The slope is a limitation affecting both uses. The shrink-swell potential is an additional limitation on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the structural damage caused by shrinking and swelling. Some land shaping is commonly needed to overcome the slope. The moderate permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome, however, by enlarging the field. Because of the slope, the lateral lines should be installed on the contour. The Case soil is generally unsuited to sewage lagoons because of the slope.

The Canlon soil is generally unsuited to building site development because of the slope and the shallow depth to bedrock.

The land capability classification is VIe, dryland. The Case soil is in Limy Upland range site, and the Canlon soil is in Shallow Limy range site.

Ck—Clark loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on ridges in the uplands. Individual areas are irregular in shape and range from 20 to several hundred acres in size.

Typically, the surface layer is grayish brown, calcareous loam about 5 inches thick. The subsurface layer is grayish brown, friable, calcareous clay loam about 5 inches thick. The subsoil is calcareous clay loam about 24 inches thick. The upper part is grayish brown and friable, and the lower part is light yellowish brown and firm. The substratum to a depth of about 60 inches is light yellowish brown, calcareous clay loam. In some areas the surface layer is noncalcareous. In other areas it is light brownish gray.

Included with this soil in mapping are small areas of Farnum, Harney, and Holdrege soils. These soils are deeper to lime and higher on the landscape than the Clark soil. They make up 10 percent of the map unit.

Figure 6.—An area of the Case-Canlon complex, 7 to 20 percent slopes, used as range.

Permeability and the shrink-swell potential are moderate in the Clark soil. Available water capacity is high. Natural fertility and runoff are medium. The surface layer is friable, and tilth is good. The soil is mildly alkaline or moderately alkaline throughout.

Most areas are used for cultivated crops. Some areas are used as range. This soil is moderately well suited to dryland wheat and sorghum. Water erosion is a hazard if cultivated crops are grown. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and conserve moisture. Sorghum is subject to iron chlorosis.

This soil is moderately well suited to irrigation. Wheat, sorghum, corn, and alfalfa are suitable irrigated crops. Terracing, farming on the contour, minimizing tillage, leaving crop residue on the surface, and managing water efficiently help to control water erosion and conserve water.

This soil is suited to range. Water erosion and soil blowing are hazards in overgrazed areas. Gullies form along some cattle trails. Maintaining an adequate plant cover helps to control water erosion and soil blowing. Fencing and other means of controlling livestock traffic patterns help to prevent gullying and give gullies time to revegetate.

The many areas where cropland joins range can be managed as habitat for upland wildlife, such as pheasants. Planting shrubs in these areas provides winter cover for the wildlife.

This soil is moderately well suited to dwellings, septic tank absorption fields, and sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations and backfilling with suitable coarse material, however, help to prevent the structural damage caused by shrinking and swelling. The moderate permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome, however, by enlarging the field. Seepage and slope are limitations on sites for sewage lagoons. Sealing the lagoon helps to control seepage. Some land shaping commonly is needed to overcome the slope.

The land capability classification is IIIe, dryland and irrigated. The range site is Limy Upland.

Cm—Clark loam, 3 to 7 percent slopes. This deep, moderately sloping, well drained soil is on ridges and side slopes in the uplands. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is grayish brown, calcareous loam about 10 inches thick. The subsoil is light yellowish brown, firm, calcareous loam about 16 inches thick. The substratum to a depth of about 60 inches is light yellowish brown, calcareous clay loam. In some areas the surface layer is light brownish gray.

Included with this soil in mapping are small areas of Farnum and Uly soils on the upper side slopes. Farnum soils are deeper to lime than Clark soils. Uly soils are silt loam throughout and have a surface layer that is not calcareous. Included soils make up about 10 percent of the map unit.

Permeability and the shrink-swell potential are moderate in the Clark soil. Available water capacity is high. Natural fertility and runoff are medium. The surface layer is friable, and tilth is good. The soil is mildly alkaline or moderately alkaline throughout.

Most areas are used as range. Some are used for cultivated crops. This soil is moderately well suited to wheat and sorghum. Water erosion is a hazard if cultivated crops are grown. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and conserve moisture. Sorghum is subject to iron chlorosis.

This soil is suited to range. Water erosion and soil blowing are hazards in overgrazed areas. Gullies form along some cattle trails. Maintaining an adequate plant cover helps to control water erosion and soil blowing. Fencing and other means of controlling livestock traffic patterns help to prevent gullying and give gullies time to revegetate.

This soil is moderately well suited to dwellings, septic tank absorption fields, and sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations and backfilling with suitable coarse material, however, help to prevent the structural damage caused by shrinking and swelling. The moderate permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome, however, by enlarging the field. Seepage and slope are limitations on sites for sewage lagoons. Sealing the lagoon helps to control seepage. Some land shaping commonly is needed to overcome the slope.

The land capability classification is IVe, dryland. The range site is Limy Upland.

Co—Coly silt loam, 4 to 9 percent slopes. This deep, moderately sloping, well drained soil is on upland side slopes. Individual areas are long and narrow and range from 5 to 500 acres in size.

Typically, the surface layer is pale brown, calcareous silt loam about 5 inches thick. The next layer is very pale brown, friable, calcareous silt loam about 7 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some areas the surface layer is very dark grayish brown and noncalcareous. In other areas it is clay loam.

Included with this soil in mapping are small areas of Harney, Holdrege, and Tobin soils. Harney and Holdrege soils have a subsoil that is more clayey than that of the Coly soil. They are on the upper side slopes. The occasionally flooded Tobin soils are on narrow flood plains along drainageways. Included soils make up about 15 percent of the map unit.

Permeability is moderate in the Coly soil, and runoff is medium. Available water capacity is high. Natural fertility is low. The surface layer is friable, and tilth is good. The soil is mildly alkaline or moderately alkaline throughout.

Nearly all areas are cultivated. This soil is poorly suited to cultivated crops. The main dryland crops are wheat and sorghum. Water erosion is a hazard if cultivated crops are grown. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and conserve moisture.

Wheat, sorghum, corn, and alfalfa are the main irrigated crops. Terracing, farming on the contour, minimizing tillage, leaving crop residue on the surface, and managing water efficiently help to control water erosion and conserve water.

This soil is moderately well suited to dwellings. The slope is a limitation. As a result, some land shaping is commonly needed.

This soil is well suited to septic tank absorption fields and is moderately well suited to sewage lagoons. Seepage and slope are limitations on sites for sewage lagoons. Sealing the lagoon helps to control seepage. If the less sloping areas are selected as sites for lagoons, less leveling and banking will be needed during construction.

The land capability classification is IVe, dryland and irrigated. The range site is Limy Upland.

Cp—Coly silt loam, 20 to 40 percent slopes. This deep, steep, well drained soil is on upland side slopes (fig. 7). Individual areas are irregular in shape and range from 500 to 1,000 acres in size.

Typically, the surface layer is pale brown, calcareous silt loam about 5 inches thick. The next layer is very pale brown, friable, calcareous silt loam about 5 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some areas the surface layer is noncalcareous.

Included with this soil in mapping are small areas of soils that are similar to Tobin soils but are calcareous at the surface. These included soils are frequently flooded and are on narrow flood plains along drainageways. They make up about 10 percent of the map unit.

Permeability is moderate in the Coly soil. Runoff is rapid. Available water capacity is high. Natural fertility is low. The soil is mildly alkaline or moderately alkaline throughout.

This soil is used as range. Because of the erosion hazard, it is unsuited to cropland. It is better suited to range. Water erosion and soil blowing are hazards in

Figure 7.—An area of Coly silt loam, 20 to 40 percent slopes.

overgrazed areas. Gullies form along some cattle trails. Maintaining an adequate plant cover helps to control water erosion and soil blowing. Fencing and other means of controlling livestock traffic patterns help to prevent gullying and give gullies time to revegetate.

This soil is generally unsuited to building site development because of the steep slope.

The land capability classification is VIIe, dryland. The range site is Loess Breaks.

Ct—Coly-Tobin silt loams, 0 to 20 percent slopes. These deep, well drained soils are along upland drainageways. The strongly sloping Coly soil is on side slopes. The nearly level Tobin soil is on bottom land. It is frequently flooded. Individual areas are long and narrow and range from 40 to a few thousand acres in size. They are about 70 percent Coly soil and 30 percent Tobin soil. The two soils occur as areas so intricately mixed or narrow that mapping them separately is not practical.

Typically, the Coly soil has a surface layer of pale brown, calcareous silt loam about 5 inches thick. The next layer is very pale brown, friable, calcareous silt loam about 7 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some areas the surface layer is noncalcareous.

Typically, the Tobin soil has a surface soil of dark grayish brown silt loam about 25 inches thick. The next layer is dark grayish brown, friable, calcareous silt loam about 8 inches thick. The substratum to a depth of about 60 inches is brown, calcareous silt loam. In some areas the surface layer is calcareous.

Permeability is moderate in both soils, and available water capacity is high. Runoff is rapid on the Coly soil and slow on the Tobin soil. Natural fertility is low in the Coly soil and high in the Tobin soil. The shrink-swell potential is moderate in the Tobin soil. The Coly soil is mildly alkaline or moderately alkaline throughout. The surface layer of the Tobin soil is neutral.

Nearly all areas are used as range. Because of the strong slope of the Coly soil and the frequent flooding on the Tobin soil, this map unit is generally unsuited to cultivated crops. It is better suited to range. The flooding is a hazard if the Tobin soil is used as range. Water erosion and soil blowing are hazards in overgrazed areas of the Coly soil. They can be controlled by maintaining an adequate plant cover.

The Coly soil is moderately well suited to dwellings and septic tank absorption fields. The slope is a limitation affecting both uses. Some land shaping is commonly needed on sites for buildings. Lateral lines in septic tank absorption fields should be installed on the contour. The Coly soil is generally unsuited to sewage lagoons because of the slope.

The Tobin soil is generally unsuited to building site development because the flooding is a severe hazard.

The land capability classification is VIe, dryland. The Coly soil is in Limy Upland range site, and the Tobin soil is in Loamy Lowland range site.

Da—Dale silt loam. This deep, nearly level, well drained soil is on stream terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is grayish brown silty clay loam about 18 inches thick. It is friable in the upper part and firm and calcareous in the lower part. The substratum to a depth of about 60 inches is brown, calcareous silt loam. In some areas the soil contains more sand. In other areas it contains more clay.

Permeability is moderate, and runoff is slow. Available water capacity and natural fertility are high. The shrink-swell potential is moderate in the subsoil. The surface layer is slightly acid and friable, and tilth is good.

About half of the acreage is used for cultivated crops, and half is used as range. The soil is well suited to dryland wheat and sorghum (fig. 8). The main limitation is a lack of sufficient rainfall. Minimizing tillage and leaving crop residue on the surface conserve moisture, help to maintain tilth, and increase the rate of water infiltration. Diversion terraces help to keep excess water from the adjacent uplands away from this soil.

This soil is well suited to irrigation. Wheat, sorghum, corn, alfalfa, and soybeans are suitable irrigated crops. Returning crop residue to the soil, minimizing tillage, and managing water efficiently help to maintain tilth and conserve water. Land leveling results in a uniform water distribution.

This soil is suited to range. No major problems affect the use of the soil as range. Soil blowing is a hazard if the range is overgrazed. It can be controlled by maintaining an adequate plant cover.

This soil is poorly suited to dwellings because of the flooding. Dikes, levees, and other structures lessen the flooding hazard. Onsite inspection and knowledge of an area's flooding history are needed when building sites are selected.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The flooding is a hazard on sites for septic tank absorption fields. Levees reduce this hazard. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the lagoon.

The land capability classification is IIc, dryland, and I, irrigated. The range site is Loamy Terrace.

Fa—Farnum loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on flats in the uplands. Individual areas are irregular in shape and range from 20 to 500 acres in size.

Figure 8.—Sorghum baled for livestock feed in an area of Dale silt loam.

Typically, the surface layer is dark grayish brown and very dark grayish brown loam about 11 inches thick. The subsoil is firm clay loam about 43 inches thick. The upper part is dark grayish brown, the next part is brown, and the lower part is light brown. The substratum to a depth of about 60 inches is light brown, calcareous clay loam. In some areas the subsoil is silty clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Carwile soils in depressions. These soils have a clayey subsoil. They make up about 5 percent of the map unit.

Permeability is moderate in the Farnum soil, and runoff is slow. Available water capacity and natural fertility are high. The shrink-swell potential is moderate in the subsoil. The surface layer is slightly acid and friable, and tilth is good.

Nearly all areas are used for cultivated crops. A few areas are irrigated. This soil is well suited to dryland wheat and sorghum. A lack of sufficient rainfall is the main limitation. Returning crop residue to the soil and minimizing tillage improve fertility and tilth and conserve moisture.

This soil is well suited to irrigation. Wheat, sorghum, corn, alfalfa, and soybeans are suitable irrigated crops. Returning crop residue to the soil, minimizing tillage, and managing water efficiently help to maintain tilth and conserve water. Land leveling results in a uniform water distribution.

This soil is moderately well suited to dwellings. The shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the structural damage caused by shrinking and swelling.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The moderate permeability restricts the absorption of effluent from septic tank systems. Increasing the size of the absorption field and installing the lateral lines below the subsoil improve the performance of the absorption field. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the lagoon.

The land capability classification is IIc, dryland, and I, irrigated. The range site is Loamy Upland.

Fb—Farnum loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on ridges in the uplands. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is dark grayish brown and very dark grayish brown loam about 11 inches thick. The subsoil is firm clay loam about 40 inches thick. The upper part is dark grayish brown, the next part is brown, and the lower part is light brown. The substratum to a depth of about 60 inches is light brown, calcareous clay loam. In some areas the subsoil is silty clay loam.

Permeability is moderate in the Farnum soil, and runoff is medium. Available water capacity and natural fertility are high. The shrink-swell potential is moderate in the subsoil. The surface layer is slightly acid and friable, and tilth is good.

Nearly all areas are used for cultivated crops. A few areas are irrigated. This soil is well suited to dryland wheat and sorghum. Water erosion is a hazard if cultivated crops are grown. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and conserve moisture.

This soil is well suited to irrigation. Wheat, sorghum, corn, alfalfa, and soybeans are suitable irrigated crops. Terracing, farming on the contour, minimizing tillage, leaving crop residue on the surface, and managing water efficiently help to control water erosion and conserve water.

This soil is moderately well suited to dwellings; however, the shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the structural damage caused by shrinking and swelling.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The moderate permeability somewhat restricts the absorption of effluent in septic tank absorption fields. Enlarging the field, however, commonly overcomes this limitation. Seepage and slope are limitations on sites for sewage lagoons. Seepage can be controlled by sealing the lagoon. Some land shaping commonly is needed to overcome the slope.

The land capability classification is IIe, dryland and irrigated. The range site is Loamy Upland.

Ha—Harney silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on broad upland ridgetops. Individual areas are irregular in shape and range from 20 to a few thousand acres in size.

Typically, the surface layer is grayish brown silt loam about 5 inches thick. The subsurface layer is dark grayish brown, friable silty clay loam about 9 inches thick. The subsoil is silty clay loam about 36 inches thick. The upper part is grayish brown and very firm; the next part is brown, firm, and calcareous; and the lower part is yellowish brown, friable, and calcareous. The substratum to a depth of about 60 inches is yellowish brown, calcareous silt loam. In some areas the subsoil is clay loam.

Included with this soil in mapping are small areas of the poorly drained Ness soils and small areas of moderately well drained soils that have a gray, clayey subsoil. Included soils are in depressions. They make up about 10 percent of the map unit.

Permeability is moderately slow in the Harney soil, and runoff is slow. Available water capacity and natural fertility are high. The shrink-swell potential is moderate in the subsoil. The surface layer is slightly acid and friable, and tilth is good.

Nearly all areas are used for cultivated crops. A few are irrigated. This soil is well suited to dryland wheat and sorghum. A lack of sufficient rainfall is the main limitation. Returning crop residue to the soil and minimizing tillage improve fertility and tilth and conserve moisture.

This soil is well suited to irrigation. Wheat, sorghum, corn, alfalfa, and soybeans are suitable irrigated crops. Returning crop residue to the soil, minimizing tillage, and managing water efficiently help to maintain tilth and conserve water. Land leveling results in a uniform water distribution.

This soil is moderately well suited to dwellings, septic tank absorption fields, and sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material, however, help to prevent the structural damage caused by shrinking and swelling. The moderately slow permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome, however, by enlarging the field or by installing the lateral lines below the subsoil. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the lagoon.

The land capability classification is IIc, dryland, and I, irrigated. The range site is Loamy Upland.

Hb—Harney silt loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on ridges in the uplands. Individual areas are irregular in shape and range from 20 to a few thousand acres in size.

Typically, the surface layer is grayish brown silt loam about 5 inches thick. The subsurface layer is dark grayish brown, friable silty clay loam about 7 inches thick. The subsoil is silty clay loam about 33 inches thick. The upper part is grayish brown and very firm; the next part is brown, firm, and calcareous; and the lower part is yellowish brown, friable, and calcareous. The substratum to a depth of about 60 inches is yellowish brown, calcareous silt loam. In some areas where the upper part of the subsoil has been mixed with the surface soil by tillage, the surface layer is silty clay loam. In places the subsoil is clay loam.

Included with this soil in mapping are small areas of Coly and Uly soils, which make up about 5 percent of the map unit. Coly soils are calcareous at the surface. Both of the included soils have a subsoil that is less clayey than that of the Harney soil. Also, they are generally lower on the landscape, but in places Coly soils are on the ridges.

Permeability is moderately slow in the Harney soil, and runoff is medium. Available water capacity and natural fertility are high. The shrink-swell potential is moderate in the subsoil. In most places, the surface layer is friable and tilth is good. In areas where the surface layer is silty clay loam, however, it is firm and tilth is fair. The surface layer is slightly acid.

Nearly all areas are used for cultivated crops. A few areas are irrigated. This soil is well suited to dryland wheat and sorghum. Water erosion is a hazard if cultivated crops are grown. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and conserve moisture.

This soil is well suited to irrigation. Wheat, sorghum, corn, alfalfa, and soybeans are suitable irrigated crops. Terracing, farming on the contour, minimizing tillage, leaving crop residue on the surface, and managing water efficiently help to control water erosion and conserve water. Gravity irrigation and bench leveling conserve soil and water.

This soil is moderately well suited to dwellings, septic tank absorption fields, and sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material, however, help to prevent the structural damage caused by shrinking and swelling. The moderately slow permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome, however, by enlarging the field or by installing the lateral lines below the subsoil. Slope and seepage are limitations on sites for sewage lagoons. Some land shaping commonly is needed to overcome the slope. Seepage can be controlled by sealing the lagoon.

The land capability classification is IIe, dryland and irrigated. The range site is Loamy Upland.

He—Hedville-Rock outcrop complex, 15 to 30 percent slopes. This map unit occurs as areas of a shallow, moderately steep and steep, somewhat excessively drained Hedville soil intricately mixed with areas of Rock outcrop. The Hedville soil is on ridges and side slopes, and the Rock outcrop is on the steeper side slopes. The landscape is dissected by deeply entrenched drainageways. Individual areas are irregular in shape and range from 20 to 200 acres in size. They are about 50 percent Hedville soil and 30 percent Rock outcrop. The soil and Rock outcrop occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Hedville soil has a surface layer of grayish brown fine sandy loam about 11 inches thick. Sandstone bedrock is at a depth of about 11 inches.

Typically, the Rock outcrop is hard sandstone.

Included with this unit in mapping are small areas of the moderately deep Lancaster soils and small areas of deep, loamy soils. Included soils are on ridges and the lower side slopes. They make up about 20 percent of the map unit.

Permeability is moderate in the Hedville soil, and runoff is rapid. Available water capacity is very low. Natural fertility is low. Root penetration is restricted by the sandstone at a depth of about 11 inches.

Nearly all areas are used as range (fig. 9). This map unit is unsuited to cultivated crops because of a severe hazard of water erosion. Also, using tillage equipment is impractical because of the slope and the rockiness. The unit is better suited to range. Droughtiness and the shallow rooting depth are concerns in managing the Hedville soil as range. Because of the moderately steep and steep slopes, water erosion is a hazard. Maintaining an adequate plant cover helps to control water erosion and conserves moisture. Reestablishing vegetation is difficult in denuded areas.

This map unit is unsuited to building site development because of the slope and the shallow depth to rock.

The land capability classification is VIIs, dryland. The Hedville soil is in Shallow Sandstone range site.

Ho—Holdrege silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on flats in the uplands. Individual areas are irregular in shape and range from 20 to 400 acres in size.

Typically, the surface layer is grayish brown silt loam about 5 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is silty clay loam about 24 inches thick. The upper part is dark grayish brown and friable; the next part is brown and firm; and the lower part is pale brown, friable, and calcareous. The substratum to a depth of about 60 inches is light yellowish brown, calcareous silt loam. In some areas the subsoil is clay loam or silty clay.

Permeability is moderate in the Holdrege soil, and runoff is slow. Available water capacity and natural fertility are high. The shrink-swell potential is moderate in the subsoil. The surface layer is slightly acid and friable, and tilth is good.

Nearly all areas are used for cultivated crops. A few are irrigated. This soil is well suited to dryland wheat and sorghum. A lack of sufficient rainfall is the main limitation. Returning crop residue to the soil and minimizing tillage improve fertility and tilth and conserve moisture.

This soil is well suited to irrigation. Wheat, sorghum, corn, alfalfa, and soybeans are suitable irrigated crops. Returning crop residue to the soil, minimizing tillage, and managing water efficiently help to maintain tilth and conserve water. Land leveling results in a uniform water distribution.

This soil is moderately well suited to dwellings. The moderate shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse

Figure 9.—An area of Hedville-Rock outcrop complex, 15 to 30 percent slopes, used as range. Cedar trees have invaded.

material help to prevent the structural damage caused by shrinking and swelling.

This soil is well suited to septic tank absorption fields and is moderately well suited to sewage lagoons. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the lagoon.

The land capability classification is IIc, dryland, and I, irrigated. The range site is Loamy Upland.

Hp—Holdrege silt loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on ridges in the uplands. Individual areas are irregular in shape and range from 20 to 500 acres in size.

Typically, the surface layer is grayish brown silt loam about 5 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 5 inches thick. The subsoil is silty clay loam about 22 inches thick. The upper part is dark grayish brown and friable; the next part is brown and firm; and the lower part is pale brown, friable, and calcareous. The substratum to a depth of about 60 inches is light yellowish brown, calcareous silt loam. In some areas the subsoil is clay loam, silty clay, or silt loam.

Included with this soil in mapping are small areas of the calcareous Coly soils. These soils are on the lower side slopes or on ridges. They make up about 5 percent of the map unit.

Permeability is moderate in the Holdrege soil, and runoff is medium. Available water capacity and natural fertility are high. The shrink-swell potential is moderate in the subsoil. The surface layer is slightly acid and friable, and tilth is good.

Nearly all areas are used for cultivated crops. A few are irrigated. This soil is well suited to dryland wheat and sorghum. Water erosion is a hazard if cultivated crops are grown. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and conserve moisture.

This soil is well suited to irrigation. Wheat, sorghum, corn, alfalfa, and soybeans are suitable irrigated crops. Terracing, farming on the contour, minimizing tillage, leaving crop residue on the surface, and managing water efficiently help to control water erosion and conserve water.

This soil is moderately well suited to dwellings. The shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the structural damage caused by shrinking and swelling.

This soil is well suited to septic tank absorption fields and is moderately well suited to sewage lagoons. Seepage and slope are limitations on sites for sewage lagoons. Seepage can be controlled by sealing the lagoon. Some land shaping commonly is needed to overcome the slope.

The land capability classification is IIe, dryland and irrigated. The range site is Loamy Upland.

Kr—Krier sandy loam, occasionally flooded. This deep, nearly level, somewhat poorly drained soil is on flood plains. It is occasionally flooded for very brief periods. Individual areas are long and narrow and are about 150 acres in size.

Typically, the surface layer is grayish brown, calcareous sandy loam about 5 inches thick. The upper 6 inches of the substratum is grayish brown, calcareous sandy loam. The next 7 inches is grayish brown, calcareous, mottled loamy sand. The lower part to a depth of about 60 inches is very pale brown, calcareous, mottled sand. In some areas the depth to sand is more than 20 inches.

Included with this soil in mapping are small areas of the somewhat excessively drained Lincoln soils on the slightly higher parts of the landscape. These soils make up about 10 percent of the map unit.

Permeability is rapid in the Krier soil, and runoff is slow. Available water capacity and fertility are low. A seasonal high water table is at a depth of 1 to 3 feet. The surface layer is moderately alkaline. The content of sodium and soluble salts in the soil adversely affects the growth of most plants.

This soil is used as range. Because of the saline-alkali condition and the low available water capacity, it is generally unsuited to cultivated crops. It is better suited to range. Droughtiness is a concern in managing the soil as range. Excess sodium and soluble salts and the flooding also are management concerns. Salt tolerant species should be favored.

This soil is unsuitable for building site development because of the flooding and the wetness.

The land capability classification is VIs, dryland. The range site is Saline Subirrigated.

Lh—Lancaster-Hedville complex, 4 to 20 percent slopes. These moderately sloping and strongly sloping soils are on uplands. The moderately deep Lancaster soil is on ridges and the lower side slopes. The shallow Hedville soil is on the steeper, upper side slopes. Individual areas are irregular in shape and range from 40 to 500 acres in size. They are about 65 percent Lancaster soil and 30 percent Hedville soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Lancaster soil has a surface soil of grayish brown loam about 13 inches thick. The subsoil is pale brown, friable loam about 10 inches thick. Weathered sandstone bedrock is at a depth of about 23 inches. In some areas the depth to sandstone is more than 40 inches. In other areas the subsoil is fine sandy loam.

Typically, the Hedville soil has a surface layer of grayish brown fine sandy loam about 11 inches thick. Hard sandstone bedrock is at a depth of about 11 inches.

Included with these soils in mapping are small areas where sandstone crops out. These areas are on convex knobs or on ledges. They make up about 5 percent of the unit.

Permeability is moderate in the Hedville and Lancaster soils, and runoff is rapid. Available water capacity is low in the Lancaster soil and very low in the Hedville soil. Natural fertility is medium in the Lancaster soil and low in the Hedville soil. The shrink-swell potential is moderate in the subsoil of the Lancaster soil. Root penetration is restricted by the sandstone at a depth of about 23 inches in the Lancaster soil and at a depth of about 11 inches in the Hedville soil. The surface layer is slightly acid in both soils.

Nearly all areas are used as range. Because of a severe hazard of water erosion, these soils are generally unsuited to cultivated crops. They are better suited to range. Droughtiness is a concern in managing the soils as range. Because of the slope, water erosion is a hazard unless an adequate plant cover is maintained. Gullies form along some cattle trails. Fencing and other means of controlling livestock traffic patterns help to prevent gullying and give gullies time to revegetate. Reestablishing vegetation is difficult in denuded areas.

The Hedville soil generally is unsuited to building site development and sanitary facilities because it is shallow over bedrock.

The Lancaster soil is moderately well suited to dwellings. The slope and the shrink-swell potential are limitations. Also, the depth to bedrock is a limitation on sites for dwellings with basements. The rock generally is soft, however, and can be easily excavated. Because of the slope, some land shaping commonly is needed. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the structural damage caused by shrinking and swelling.

The Lancaster soil is moderately well suited to local roads and streets. Low strength, the slope, and the potential for frost action are limitations. Building the roads and streets on raised, well compacted fill material, establishing adequate side ditches, and installing culverts reduce wetness and thus help to prevent the damage caused by frost action. The surface pavement and base material should be thick enough to compensate for the low strength of the soil. Because of the slope, some land shaping commonly is needed.

Because of the depth to bedrock, the Lancaster soil is poorly suited to septic tank absorption fields and sewage lagoons. The deeper, less sloping soils on the lower side slopes are well suited to onsite sewage disposal systems.

The land capability classification is VIe, dryland. The Lancaster soil is in Loamy Upland range site, and the Hedville soil is in Shallow Sandstone range site.

Ln—Lincoln sandy loam, occasionally flooded. This deep, nearly level, somewhat excessively drained soil is on flood plains. It is occasionally flooded for brief periods. Individual areas are long and narrow and range from 5 to 200 acres in size.

Typically, the surface layer is grayish brown, calcareous sandy loam about 8 inches thick. The next layer is brown, calcareous, loose loamy fine sand about 7 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous fine sand. In some areas the surface soil is more than 10 inches thick. In other areas the soil is noncalcareous throughout.

Included with this soil in mapping are small areas of Canadian, Plevna, and Waldeck soils. The well drained Canadian soils are on the slightly higher stream terraces. The poorly drained Plevna soils and the somewhat poorly drained Waldeck soils are in the slightly lower positions on the landscape. Included soils make up about 15 percent of the map unit.

Permeability is rapid in the Lincoln soil, and runoff is slow. Available water capacity and natural fertility are low. A seasonal high water table is at a depth of 5 to 8 feet. The surface layer is moderately alkaline and friable, and tilth is good.

Nearly all areas are used as range. Because of low fertility, droughtiness, and flooding, this soil generally is unsuited to cultivated crops. It is better suited to range. The droughtiness and the hazard of flooding are concerns in managing the soil as range. Floodwater occasionally causes scouring and deposits sand and silt. Water erosion and soil blowing are hazards unless an adequate plant cover is maintained.

This soil is generally unsuited to building site development because of the flooding.

The land capability classification is VIw, dryland. The range site is Sandy Lowland.

Na—Naron fine sandy loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on flats in the uplands. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is brown fine sandy loam about 10 inches thick. The subsoil is brown, friable sandy clay loam about 38 inches thick. The substratum to a depth of about 60 inches is yellowish brown fine sandy loam. In some areas the subsoil is clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Carwile soils in depressions. These soils have a clayey subsoil. They make up about 5 percent of the map unit.

Permeability is moderate in the Naron soil, and runoff is slow. Available water capacity is moderate, and natural fertility is medium. The surface layer is slightly acid and very friable, and tilth is good.

Nearly all areas are used for cultivated crops. A few areas are irrigated. This soil is well suited to dryland wheat and sorghum. Soil blowing is a hazard if cultivated crops are grown. Stubble mulch tillage, minimum tillage, and wind stripcropping help to control soil blowing and conserve moisture.

This soil is well suited to irrigation. Wheat, sorghum, corn, alfalfa, and soybeans are suitable irrigated crops. Minimizing tillage, leaving crop residue on the surface, and managing water efficiently help to control soil blowing and conserve water.

This soil is well suited to dwellings and septic tank absorption fields. It is poorly suited to sewage lagoons because of seepage. Sealing the lagoon helps to control seepage.

The land capability classification is IIe, dryland, and I, irrigated. The range site is Sandy.

Nb—Naron fine sandy loam, 1 to 3 percent slopes. This deep, undulating, well drained soil is on uplands. Individual areas are irregular in shape and range from 10 to 500 acres in size.

Typically, the surface layer is brown fine sandy loam about 10 inches thick. The subsoil is brown, friable sandy clay loam about 38 inches thick. The substratum to a depth of about 60 inches is yellowish brown fine sandy loam. In some areas the subsoil is clay loam.

Included with this soil in mapping are small areas of Carwile and Pratt soils. The somewhat poorly drained Carwile soils are in depressions. They have a clayey subsoil. Pratt soils have a loamy fine sand subsoil. They are in the higher areas. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Naron soil, and runoff is slow. Available water capacity is moderate, and natural fertility is medium. The surface layer is slightly acid and very friable, and tilth is good.

Nearly all areas are used for cultivated crops. Some are irrigated. This soil is well suited to dryland wheat and sorghum. Soil blowing is a hazard if cultivated crops are grown. Stubble mulch tillage, minimum tillage, and wind stripcropping help to control soil blowing and conserve moisture. Terraces and contour farming, which are feasible in some areas, can help to control water erosion.

This soil is well suited to irrigation. Wheat, sorghum, corn, alfalfa, and soybeans are suitable irrigated crops.

Minimizing tillage, leaving crop residue on the surface, and managing water efficiently help to control soil blowing and conserve water.

This soil is well suited to dwellings and septic tank absorption fields. It is poorly suited to sewage lagoons because of seepage. Sealing the lagoon helps to control seepage.

The land capability classification is IIe, dryland and irrigated. The range site is Sandy.

Ne—Ness silty clay. This deep, nearly level, poorly drained soil is in shallow upland depressions. It is subject to ponding. Individual areas are round or elongated and range from 5 to 75 acres in size.

Typically, the surface layer is gray silty clay about 11 inches thick. The subsurface layer is gray, very firm silty clay about 22 inches thick. The next layer is light brownish gray, very firm silty clay about 5 inches thick. The substratum to a depth of about 60 inches is pale brown, calcareous silty clay loam.

Included with this soil in mapping are small areas of a moderately well drained soil. This included soil has a silty clay loam surface layer and a silty clay subsoil. It is in the slightly higher areas. It makes up about 5 percent of the map unit.

Permeability is very slow in the Ness soil, and runoff is ponded. Available water capacity is high. Natural fertility is medium. The shrink-swell potential is high in the upper part of the soil. The surface layer is very firm, and tilth is poor. The soil is neutral or mildly alkaline in the upper part.

The larger areas of this soil support native vegetation, but the smaller areas are cultivated along with the surrounding soils. This soil is poorly suited to cultivated crops. The main concerns of management are controlling the ponding and soil blowing and maintaining tilth and fertility. The ponding delays planting and harvesting. In seasons of heavy rainfall, crops are drowned and lost. Soil blowing is a hazard during dry periods unless the soil is protected by crop residue or native vegetation. If the soil is tilled when it is too wet or too dry, clods form and the natural soil structure is destroyed.

This soil is not well suited to range because the ponding restricts the growth of native grasses. The composition of native plants and the amount of forage vary.

The ponding on this soil results in shallow water areas that can be used as habitat by waterfowl and other kinds of wildlife. The adjacent soils generally are used for cultivated crops, which supply food and nesting areas.

This soil is generally unsuited to building site development because of the ponding.

The land capability classification is VIw, dryland. No range site is assigned.

Nw—New Cambria silty clay. This deep, nearly level, moderately well drained soil is on stream terraces. It is subject to rare flooding, which lasts for very brief periods. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is grayish brown silty clay about 12 inches thick. It is calcareous in the lower part. The subsoil is brown, very firm, calcareous silty clay about 24 inches thick. The substratum to a depth of about 60 inches is pale brown, calcareous silty clay.

Permeability and runoff soils are slow. Available water capacity, the shrink-swell potential, and natural fertility are high. The surface layer is neutral and very firm, and tilth is fair.

This soil is well suited to dryland wheat and sorghum. The main limitation is the clayey texture. Because of the content of clay, the soil takes in water slowly and releases it slowly to plants. If the soil is tilled when it is too wet or too dry, the natural soil structure is destroyed and clods form. Crops are sometimes damaged by too much moisture during periods of excessive rainfall. During periods of low rainfall, however, conservation of water can be a concern of management. Minimizing tillage and returning crop residue to the soil help to maintain tilth and fertility and conserve moisture.

This soil can be irrigated if an adequate water supply is available. Wheat, sorghum, corn, alfalfa, and soybeans are suitable irrigated crops. Minimizing tillage, returning crop residue to the soil, and managing water efficiently help to maintain tilth and conserve water. Land leveling results in a uniform water distribution.

Most areas support native grasses and are used for grazing. This soil is suited to range. No major problems affect the use of the soil as range. Compaction can become a problem, but it can be controlled by restricted grazing during wet periods.

This soil is poorly suited to dwellings because of the hazard of flooding and the high shrink-swell potential. Dikes, levees, and other structures lessen the flooding hazard. Onsite inspection and knowledge of an area's flooding history are needed when building sites are selected. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the structural damage caused by shrinking and swelling. The soil is well suited to sewage lagoons. It is generally unsuited to septic tank absorption fields because of the slow permeability.

The land capability classification is IIs, dryland and irrigated. The range site is Clay Terrace.

Oe—Owens clay, 6 to 25 percent slopes. This shallow, strongly sloping to steep, well drained soil is on narrow divides and side slopes in the uplands. Individual areas are irregular in shape and range from 40 to several hundred acres in size.

Typically, the surface layer is grayish brown, calcareous clay about 6 inches thick. The subsoil is grayish brown, very firm, calcareous clay about 9 inches thick. Gray, clayey shale bedrock is at a depth of about 15 inches. In some areas the depth to shale is more than 20 inches. In other areas the surface layer is stony clay.

Included with this soil in mapping are small areas of shale outcrop, barren saline-alkali soils, and clayey alluvial soils. The shale outcrop is on the lower, steeper slopes. The saline-alkali soils are on foot slopes. The alluvial soils are along narrow drainageways. Included areas make up about 10 percent of the map unit.

Permeability is very slow in the Owens soil, and runoff is rapid. Available water capacity is very low. Natural fertility is low. The shrink-swell potential is high. Root penetration is restricted by the shale at a depth of about 15 inches.

Nearly all areas are used as range (fig. 10). Because of a severe hazard of water erosion, this soil is generally unsuited to cultivated crops. It is better suited to range. Droughtiness is a concern in managing the soil as range. Because of the slope, water erosion is a hazard unless an adequate plant cover is maintained. Gullies form along some cattle trails. During extended wet periods, the soil tends to shear and slide down the steeper slopes. The sheared areas are bare. Reestablishing vegetation is difficult in the gullied or sheared areas. Fencing and other means of controlling livestock traffic patterns help to prevent gullying and soil slippage.

This soil generally is unsuitable for building site development because of the slope and the shallow depth to weathered bedrock.

The land capability classification is VIe, dryland. The range site is Blue Shale.

Pe—Plevna loam, frequently flooded. This deep, nearly level, poorly drained soil is on flood plains. Individual areas are long and narrow and range from 10 to several hundred acres in size.

Typically, the surface layer is grayish brown, calcareous loam about 5 inches thick. The subsurface layer is about 10 inches thick. It is grayish brown and mottled. The upper part is friable, calcareous loam, and the lower part is very friable sandy loam. The subsoil is about 33 inches thick. It is light brownish gray, mottled, and very friable. The upper part is sandy loam, and the lower part is calcareous fine sandy loam. The substratum to a depth of about 60 inches is pale brown sand. In some areas the subsoil is loamy sand or sand.

Permeability is moderately rapid in the Plevna soil, and runoff is slow. Available water capacity is moderate. Natural fertility is medium. The surface layer is

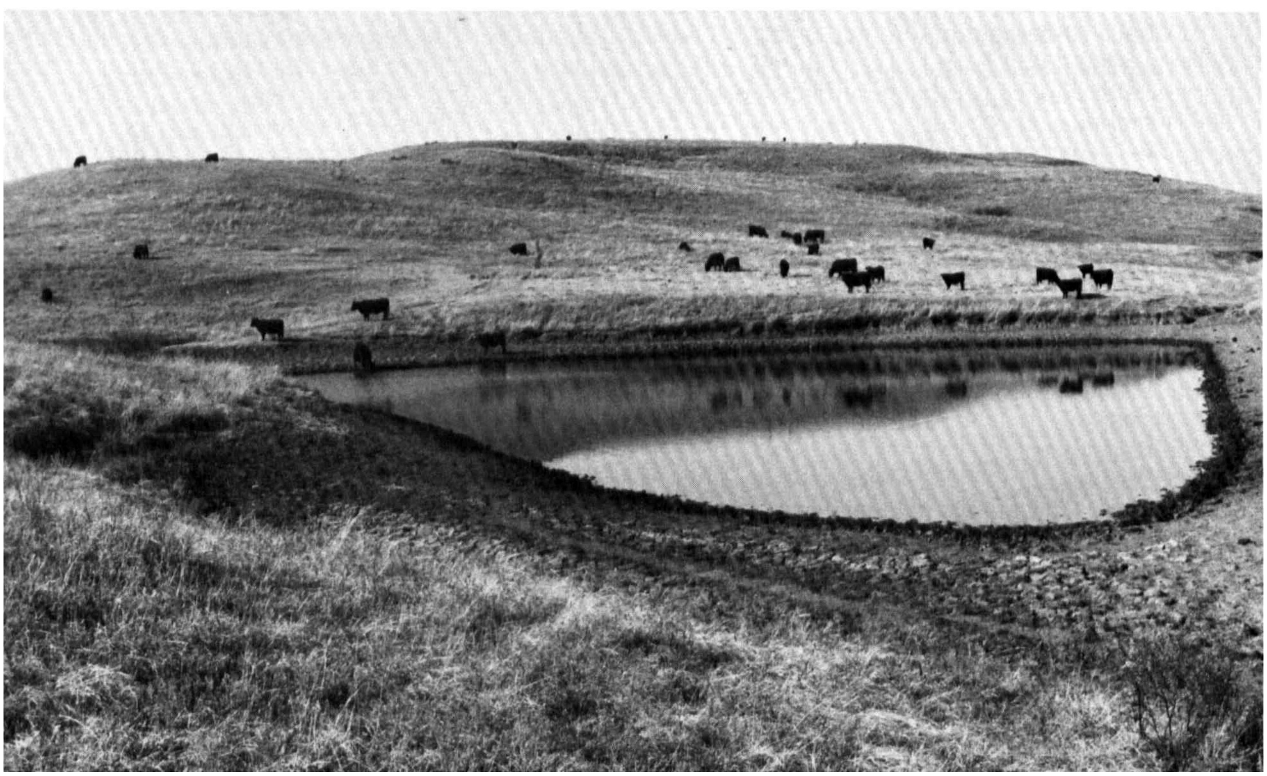

Figure 10.—A stock-water pond in an area of Owens clay, 6 to 25 percent slopes.

moderately alkaline. A seasonal high water table is within a depth of 2 feet.

Nearly all areas are used as range. Because of the wetness and the frequent flooding, this soil is generally unsuited to cultivated crops. It is better suited to range. No major problems affect the use of the soil as range. The flooding and the wetness can be problems, however, in the spring.

This soil has good potential for wetland wildlife habitat. Excavated ponds provide habitat areas for waterfowl.

This soil is generally unsuited to building site development because of the flooding and the wetness.

The land capability classification is Vw, dryland. The range site is Subirrigated.

Pr—Pratt loamy fine sand, undulating. This deep, well drained soil is on uplands. Individual areas are irregular in shape and range from 20 to several hundred acres in size.

Typically, the surface layer is brown loamy fine sand about 12 inches thick. The subsoil is light yellowish brown, very friable loamy fine sand about 24 inches thick. The substratum to a depth of about 60 inches is light yellowish brown loamy fine sand. In some areas the subsoil is fine sandy loam.

Included with this soil in mapping are small areas of Carwile and Naron soils. The somewhat poorly drained Carwile soils are in depressions. They have a clayey subsoil. The loamy Naron soils are nearly level. Included soils make up about 10 percent of the map unit.

Permeability is rapid in the Pratt soil, and runoff is slow. Available water capacity and natural fertility are low. The soil is slightly acid or neutral throughout. The surface layer is very friable, and tilth is good.

Most areas are used for cultivated crops. Many are irrigated. This soil is moderately well suited to dryland wheat and sorghum. Soil blowing is a hazard if cultivated crops are grown. It can be controlled by stubble mulch tillage, wind stripcropping, and minimum tillage.

This soil is well suited to irrigation. Wheat, sorghum, alfalfa, corn, and soybeans are suitable irrigated crops. Minimizing tillage, leaving crop residue on the surface, and managing water efficiently help to control soil blowing and conserve water.

This soil is suited to range, but it is droughty. Also, soil blowing is a hazard if the range is overgrazed. It can be controlled by maintaining an adequate plant cover.

This soil is well suited to dwellings. Because of seepage and a poor filtering capacity, however, it generally is unsuitable as a site for sewage lagoons and is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity may result in the pollution of shallow ground water. The areas where the subsoil is loamy are better sites for the absorption fields.

The land capability classification is IIIe, dryland and irrigated. The range site is Sands.

Ps—Pratt loamy fine sand, rolling. This deep, well drained soil is on uplands. Individual areas are irregularly shaped or elongated and range from 20 to several hundred acres in size.

Typically, the surface layer is brown loamy fine sand about 10 inches thick. The subsoil is light yellowish brown, very friable loamy fine sand about 22 inches thick. The substratum to a depth of about 60 inches is light yellowish brown loamy fine sand. In a few areas the subsoil is fine sandy loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Carwile soils in depressions. These soils have a clayey subsoil. They make up about 5 percent of the map unit.

Permeability is rapid in the Pratt soil, and runoff is slow. Available water capacity and natural fertility are low. The soil is slightly acid or neutral throughout. The surface layer is very friable, and tilth is good.

About half of the acreage is cultivated, and about half is range or has been reseeded to native grasses. Some areas are irrigated. This soil is moderately well suited to dryland wheat and sorghum. Soil blowing is a hazard if cultivated crops are grown. It can be controlled by stubble mulch tillage, wind stripcropping, and minimum tillage.

This soil is well suited to irrigation. Wheat, sorghum, alfalfa, corn, and soybeans are suitable irrigated crops. Minimizing tillage, leaving crop residue on the surface, and managing water efficiently help to control soil blowing and conserve water.

This soil is suited to range, but it is droughty. Also, soil blowing is a hazard if the range is overgrazed. It can be controlled by maintaining an adequate plant cover.

This soil is moderately well suited to dwellings. Because of the slope, some land shaping commonly is needed.

Because of seepage, this soil generally is unsuitable as a site for sewage lagoons. It is poorly suited to septic tank absorption fields because the sandy substratum does not adequately filter the effluent. The poor filtering capacity may result in the pollution of shallow ground water. The areas where the subsoil is fine sandy loam are better sites for sanitary facilities.

The land capability classification is IVe, dryland and irrigated. The range site is Sands.

Pt—Pratt-Tivoli loamy fine sands, rolling. These deep soils are on uplands. The well drained Pratt soil is on the lower side slopes. The excessively drained Tivoli soil is on the crest of knolls and on the upper slopes. Individual areas are irregular in shape and range from 40 to a few thousand acres in size. They are about 60 percent Pratt soil and 40 percent Tivoli soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Pratt soil has a surface layer of brown loamy fine sand about 10 inches thick. The subsoil is light yellowish brown, very friable loamy fine sand about 22 inches thick. The substratum to a depth of about 60 inches is light yellowish brown loamy fine sand. In a few areas the subsoil is fine sandy loam.

Typically, the Tivoli soil has a surface layer of brown loamy fine sand about 7 inches thick. The next layer is light yellowish brown, very friable fine sand about 11 inches thick. The substratum to a depth of about 60 inches is light yellowish brown fine sand.

Permeability is rapid in both soils. Runoff is slow on the Pratt soil and very slow on the Tivoli soil. Available water capacity and natural fertility are low in both soils.

Most areas are used as range. Some are used for irrigated crops. These soils are generally unsuited to dryland crops because of a severe hazard of soil blowing. Wheat, sorghum, alfalfa, and corn are the main irrigated crops. Minimizing tillage, leaving crop residue on the surface, and managing water efficiently help to control soil blowing and conserve water.

These soils are suited to range, but they are droughty. Also, soil blowing is a hazard if the range is overgrazed. It can be controlled by maintaining an adequate plant cover.

These soils have fair potential for rangeland wildlife habitat. Lesser prairie chickens often use the areas where the range is in good or excellent condition.

These soils are moderately well suited to dwellings. The slope is a limitation. As a result, some land shaping commonly is needed.

These soils generally are unsuitable as sites for sewage lagoons because of seepage. They are poorly suited to septic tank absorption fields. They readily absorb but do not adequately filter the effluent in these fields. The poor filtering capacity may result in the pollution of shallow ground water. The areas where the subsoil is loamy are better sites.

The land capability classification is VIe, dryland, and IVe, irrigated. The range site is Sands.

Qw—Quinlan-Woodward loams, 6 to 25 percent slopes. These strongly sloping to steep, well drained soils are on uplands. The moderately deep Woodward soil is on ridges and the lower side slopes. The shallow Quinlan soil is on the steeper, upper side slopes. Individual areas are irregular in shape and range from 40 to 500 acres in size. They are about 50 percent Quinlan soil and 40 percent Woodward soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Quinlan soil has a surface layer of reddish brown, calcareous loam about 7 inches thick. The subsoil is reddish brown, friable, calcareous loam about 8 inches thick. Calcareous sandstone bedrock is at a depth of about 15 inches.

Typically, the Woodward soil has a surface layer of reddish brown, calcareous loam about 8 inches thick. The subsoil is reddish brown, friable, calcareous loam about 19 inches thick. Calcareous sandstone bedrock is at a depth of about 27 inches. In some areas the depth to sandstone is more than 40 inches.

Included with these soils in mapping are small areas where sandstone crops out. These areas are on knobs. Also included are narrow areas of calcareous, loamy alluvial soils along drainageways. Included areas make up about 10 percent of the map unit.

Permeability is moderate in the Quinlan and Woodward soils, and runoff is rapid. Natural fertility is low. Available water capacity is very low in the Quinlan soil and low in the Woodward soil. Root penetration is restricted at a depth of about 15 inches in the Quinlan soil and at a depth of about 27 inches in the Woodward soil.

Nearly all areas are used as range. Because of a severe hazard of water erosion, these soils are generally unsuited to cultivated crops. They are better suited to range. Droughtiness is a concern in managing these soils as range. Because of the loamy surface layer and the slope, water erosion and soil blowing are hazards unless an adequate plant cover is maintained. Gullies form along some cattle trails. Fencing and other means of controlling livestock traffic patterns help to prevent gullying and give gullies time to revegetate. Establishing vegetation is difficult in denuded areas.

The Woodward soil is moderately well suited to dwellings. Because the slope is a limitation, some land shaping commonly is needed. The depth to bedrock also is a limitation, especially on sites for dwellings with basements. The bedrock generally is soft, however, and can be easily excavated. The Quinlan soil is poorly suited to dwellings because it is shallow over bedrock. The Woodward soil and the deep included soils are better sites.

These soils generally are unsuited to septic tank absorption fields and sewage lagoons because of the depth to bedrock. The deep included soils are better sites.

The land capability classification is VIe, dryland. The Quinlan soil is in Shallow Prairie range site, and the Woodward soil is in Loamy Upland range site.

Sh—Shellabarger loam, 2 to 6 percent slopes. This deep, moderately sloping, well drained soil is on uplands. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is reddish brown loam about 11 inches thick. The subsoil is about 33 inches thick. The upper part is reddish brown, friable sandy clay loam, and the lower part is brown, very friable sandy loam. The substratum to a depth of about 60 inches is light brown sandy loam. In some areas the subsoil is clay loam.

Included with this soil in mapping are small areas of Albion and Clark soils. The somewhat excessively drained Albion soils are on the lower side slopes. The calcareous Clark soils are on the upper side slopes or on knolls. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Shellabarger soil, and runoff is medium. Available water capacity is moderate, and natural fertility is medium. The surface layer is slightly acid and friable, and tilth is good.

About 75 percent of the acreage is used as range, and the rest is used for cultivated crops. This soil is moderately well suited to wheat and sorghum. Water erosion and soil blowing are hazards if cultivated crops are grown. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and soil blowing and conserve moisture.

This soil is suited to range. No major problems affect the use of this soil as range. Water erosion and soil blowing are hazards if the range is overgrazed. They can be controlled by maintaining an adequate plant cover.

The many areas where cropland joins range can be managed as habitat for upland wildlife, such as pheasants. Planting shrubs in these areas provides winter cover for the wildlife.

This soil is well suited to dwellings and septic tank absorption fields. It is only moderately well suited to sewage lagoons because slope and seepage are limitations. Seepage can be controlled by sealing the lagoon. Some land shaping commonly is needed to overcome the slope.

The land capability classification is IIIe, dryland and irrigated. The range site is Sandy.

Th—Tivoli fine sand, hilly. This deep, excessively drained soil is on uplands. Individual areas are irregular in shape and range from 40 to a few thousand acres in size.

Typically, the surface layer is brown fine sand about 6 inches thick. The substratum to a depth of about 60 inches is light yellowish brown fine sand.

Permeability is rapid, and runoff is very slow. Available water capacity and natural fertility are low. The surface layer is neutral.

Nearly all areas are used as range. Because of a very severe hazard of soil blowing, this soil is unsuited to cultivated crops. It is better suited to range. Droughtiness is a concern in managing the soil as range. Soil blowing is a hazard if the range is overgrazed. It can be controlled by maintaining an adequate plant cover.

This soil has fair potential for rangeland wildlife habitat. Lesser prairie chickens often use the areas where the range is in good or excellent condition.

This soil is generally unsuited to building site development because of the slope.

The land capability classification is VIIe, dryland. The range site is Choppy Sands.

To—Tobin silt loam, channeled. This deep, nearly level, well drained soil is on narrow flood plains dissected by meandering streams. It is frequently flooded for very brief periods. Individual areas are long and narrow and range from 40 to 600 acres in size.

Typically, the surface soil is dark grayish brown silt loam about 25 inches thick. The next layer is dark grayish brown, friable, calcareous silt loam about 8 inches thick. The substratum to a depth of about 60 inches is brown, calcareous silt loam. In some areas the soil is loam throughout. In other areas the surface layer is calcareous.

Included with this soil in mapping are small areas of the calcareous Case and Coly soils. These soils are in the steeper areas on uplands. They make up about 5 percent of the map unit.

Permeability is moderate in the Tobin soil, and runoff is slow. Available water capacity and natural fertility are high. The shrink-swell potential is moderate throughout the soil. The surface soil is neutral.

Nearly all areas are used as range. This soil is generally unsuited to cultivated crops because of the flooding. Also, operating farm machinery is difficult along the meandering stream channels. The soil is better suited to range. The flooding and the deposition and channeling caused by floodwater are problems affecting the use of this soil as range.

The diverse vegetative community common on this soil provides habitat for many kinds of wildlife. The wildlife population often can be increased by providing food and a permanent water supply in the adjacent areas.

This soil is generally unsuited to building site development because of the flooding.

The land capability classification is Vw, dryland. The range site is Loamy Lowland.

Ts—Tobin silt loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains. Individual areas are long and narrow and range from 20 to 500 acres in size.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 17 inches thick. The next layer is dark grayish brown, friable, calcareous silt loam about 8 inches thick. The substratum to a depth of about 60 inches is brown, calcareous silt loam. In some areas the surface layer is calcareous.

Permeability is moderate, and runoff is slow. Available water capacity and natural fertility are high. The shrink-swell potential is moderate throughout the soil. The surface layer is neutral and friable, and tilth is good.

Most areas are used for cultivated crops. This soil is well suited to wheat and sorghum. The flooding is a hazard if cultivated crops are grown. Most floods are of short duration. Planting and harvesting are delayed in some years because of the wetness. Terraces, contour farming, and detention dams on the adjacent uplands can decrease the severity of the flooding. Minimizing tillage and leaving crop residue on the surface conserve moisture, help to maintain tilth, and increase the rate of water infiltration.

This soil is suited to range. No major problems affect the use of this soil as range.

This soil is generally unsuited to building site development because of the flooding.

The land capability classification is IIw, dryland and irrigated. The range site is Loamy Lowland.

Uc—Uly silt loam, 3 to 7 percent slopes. This deep, moderately sloping, well drained soil is on upland side slopes. Individual areas are mostly long and narrow and range from 10 to 300 acres in size.

Typically, the surface layer is grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 4 inches thick (fig. 11). The subsoil is friable silt loam about 12 inches thick. The upper part is brown, and the lower part is pale brown and calcareous. The substratum to a depth of about 60 inches is light yellowish brown, calcareous silt loam. In some areas the surface layer is calcareous.

Included with this soil in mapping are small areas of Harney and Tobin soils. Harney soils have a subsoil that is more clayey than that of the Uly soil. They are on the upper slopes. The occasionally flooded Tobin soils are on narrow flood plains along drainageways. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Uly soil, and runoff is medium. Available water capacity and natural fertility are high. The surface layer is neutral and friable, and tilth is good.

About half of the acreage is used for cultivated crops, and half is range. This soil is moderately well suited to dryland wheat and sorghum. Water erosion is a hazard if cultivated crops are grown. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and conserve moisture.

This soil is only moderately well suited to irrigation because of the slope. Wheat, sorghum, corn, and alfalfa are suitable irrigated crops. Terracing, farming on the contour, minimizing tillage, leaving crop residue on the surface, and managing water efficiently help to control water erosion and conserve water.

This soil is suited to range. No major problems affect the use of this soil as range. Water erosion and soil blowing are hazards if the range is overgrazed. They can be controlled by maintaining an adequate plant cover.

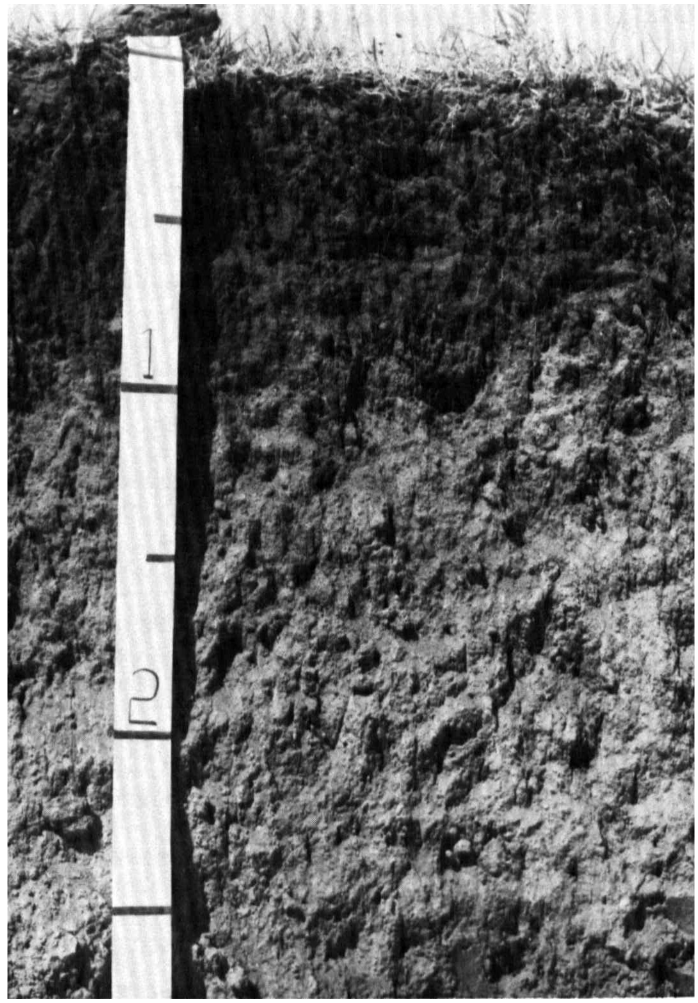

Figure 11.—Typical profile of Uly silt loam, 3 to 7 percent slopes. This soil is dark to a depth of about 10 inches. Depth is shown in feet.

The many areas where cropland joins range can be managed as habitat for upland wildlife, such as pheasants. Planting shrubs in these areas provides winter cover for the wildlife.

This soil is well suited to dwellings and septic tank absorption fields and is moderately well suited to sewage lagoons. Seepage and slope are limitations on sites for lagoons. If the less sloping areas are selected as sites for lagoons, less leveling and banking will be needed during construction. Sealing the lagoon helps to control seepage.

The land capability classification is IIIe, dryland and irrigated. The range site is Loamy Upland.

Wa—Waldeck loam, occasionally flooded. This deep, nearly level, somewhat poorly drained soil is on flood plains. Individual areas are long and narrow and range from 10 to 200 acres in size.

Typically, the surface soil is dark grayish brown, calcareous loam about 14 inches thick. The next layer is pale brown, very friable, calcareous fine sandy loam about 12 inches thick. The upper part of the substratum is pale brown, mottled, calcareous fine sandy loam. The lower part to a depth of about 60 inches is very pale brown, calcareous fine sand. In some areas the substratum is loam. In other areas the soil is mottled near the surface.

Included with this soil in mapping are small areas of the well drained Canadian and somewhat excessively drained Lincoln soils on the slightly higher parts of the landscape. These soils make up about 10 percent of the map unit.

Permeability is moderately rapid in the Waldeck soil, and runoff is slow. Available water capacity is moderate, and natural fertility is medium. The surface layer is moderately alkaline and friable, and tilth is good. A seasonal high water table is at a depth of 2 to 4 feet.

Nearly all areas support native grasses. This soil is suited to range. No major problems affect the use of this soil as range. The flooding and the wetness can be problems, however, in the spring.

This soil is moderately well suited to wheat and sorghum. The flooding and the seasonal high water table are management concerns, but the crops commonly benefit from the additional moisture. Planting and harvesting are delayed in some years because of the wetness. Soil blowing is a hazard during dry periods. Minimizing tillage and leaving crop residue on the surface help to control soil blowing and conserve moisture.

This soil is generally unsuited to building site development because of the flooding.

The land capability classification is IIIw, dryland and irrigated. The range site is Subirrigated.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil economically to produce a sustained high yield of crops. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 193,000 acres in the survey area, or nearly 42 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in the central and southwestern parts, mainly in associations 3 through 6, which are described under the heading "General Soil Map Units." The crops grown on this land, mainly wheat and grain sorghum, account for an estimated two-thirds of the county's total agricultural income each year.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in this section. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

The map units that meet the soil requirements for prime farmland are:

An Albion sandy loam, 1 to 4 percent slopes
Ca Canadian fine sandy loam
Ce Case clay loam, 2 to 7 percent slopes
Ck Clark loam, 1 to 3 percent slopes
Cm Clark loam, 3 to 7 percent slopes
Da Dale silt loam
Fa Farnum loam, 0 to 1 percent slopes
Fb Farnum loam, 1 to 3 percent slopes
Ha Harney silt loam, 0 to 1 percent slopes
Hb Harney silt loam, 1 to 3 percent slopes
Ho Holdrege silt loam, 0 to 1 percent slopes
Hp Holdrege silt loam, 1 to 3 percent slopes
Na Naron fine sandy loam, 0 to 1 percent slopes
Nb Naron fine sandy loam, 1 to 3 percent slopes
Nw New Cambria silty clay

Sh	Shellabarger loam, 2 to 6 percent slopes
Ts	Tobin silt loam, occasionally flooded
Uc	Uly silt loam, 3 to 7 percent slopes
Wa	Waldeck loam, occasionally flooded

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey of Kiowa County can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

The soils in the survey area are assigned to a land capability classification and a range site at the end of each map unit description and in tables 5 and 6. The interpretive groups for each map unit also are shown in the section "Interpretive Groups," which follows the tables at the back of this survey.

Crops

John C. Dark, conservation agronomist, Soil Conservation Service, helped prepare this section.

General management needed for crops is suggested in this section. The crops best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops are listed.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 56 percent of the acreage in Kiowa County is used for cultivated crops or is summer fallowed. During the period 1970 to 1980, wheat was grown on about 42 percent of the cropland; sorghum on 12 percent; and corn, soybeans, alfalfa, and other minor crops on 18 percent (*4*). About 28 percent was summer fallowed.

The acreage used for corn and for alfalfa and other kinds of hay has been increasing gradually. The acreage used for soybeans, although still representing only a small percent of the cropland, has been increasing.

About 17 percent of the cropland is irrigated. Grain sorghum, corn, wheat, soybeans, and alfalfa are the principal irrigated crops. Wheat is double cropped with soybeans, grain sorghum, or corn on some irrigated land.

Crop production can be increased on most farms by applying the latest crop production technology. This soil survey can facilitate the application of such technology. The main management needs on the cropland in Kiowa County are measures that control water erosion and soil blowing, make the most efficient use of available water, and maintain soil tilth and fertility.

Water erosion is the major hazard on about 50 percent of the cropland in the county. It is a hazard on the soils that have a silt loam, loam, or clay loam surface layer and a slope of more than 1 percent. If the surface is unprotected by a crop or crop residue, soil blowing is a hazard, particularly on the soils that have a loamy fine sand or fine sandy loam surface layer.

Loss of the surface layer through erosion is damaging because it reduces productivity and can result in the pollution of streams. Productivity is reduced because most of the available plant nutrients and organic matter are in the surface layer. If the surface layer is removed, these plant nutrients are no longer available for crop growth. Keeping the surface layer in place is particularly important on soils that have an infertile subsoil, such as Clark soils. Most or all of the original surface layer has already been lost from the moderately sloping, cultivated Case and Coly soils. Loss of the surface layer is also damaging on soils that have a moderately clayey, firm subsoil, such as Farnum and Harney soils. Preparing a good seedbed and tilling are more difficult in the more clayey spots that remain after the original friable surface layer has eroded away.

In many areas erosion on cropland results in the pollution of streams by sediment, fertilizers, pesticides, and herbicides. Controlling erosion minimizes this pollution and thus improves water quality for all uses.

Measures that control erosion provide a protective cover of crops or crop residue, reduce the runoff rate, and increase the rate of water infiltration. A combination of several practices is more effective in controlling erosion than a single practice. A cropping system that keeps a plant cover on the surface for extended periods helps to control erosion and conserves moisture. Tilling the soil as few times as practicable is an effective method of leaving crop residue on the surface. Minimum tillage, terraces, diversions, contour farming, and a cropping system that includes close-growing crops as well as row crops reduce the runoff rate and help to control erosion (fig. 12).

Terraces reduce the length of slopes and thus also reduce the runoff rate and the susceptibility to erosion. Contour farming should generally be used in combination with terraces. Terraces are most effective on deep, well drained soils that have uniform, regular slopes. Most of the arable soils in the county that are subject to water erosion have those characteristics.

Soil blowing is a hazard on the more sandy soils in the county, such as Albion, Attica, Canadian, Carwile, Naron, and Pratt soils. It can be controlled by wind stripcropping, field windbreaks, and conservation tillage systems, such as stubble mulching.

Measures that maintain or improve fertility and tilth are needed on the soils used for crops. Applications of nitrate and phosphate fertilizer are effective on most of the arable soils in the county, especially the sandy soils. On all soils the kinds and amounts of fertilizer to be applied should be based on the results of soil tests, on the needs of the crop, on previous experience, and on the expected level of yields. The Cooperative Extension

Figure 12.—Terraces and contour farming in an area of Harney soils.

Service can help to determine the kinds and amounts needed.

Soil tilth is an important factor in the infiltration of water into the soil, the preparation of a seedbed, and the germination of seeds. Soils with good tilth are granular and porous. Organic matter affects fertility and tilth because it provides nitrogen, increases the rate of water intake, helps to prevent surface crusting, and helps to control erosion. Several of the soils in the county that are used for crops have a surface layer of silt loam, loam, or clay loam. A surface crust forms during periods of intense rainfall. The crusted surface is hard when dry and is nearly impervious to water. Because of the hard surface, the runoff rate increases. Regularly adding organic material improves soil structure and helps to prevent surface crusting. Leaving crop residue on the surface also helps to prevent crusting.

A drainage system is a minor management need on a small acreage of cropland in the county. A surface drainage system improves the timeliness of tillage, planting, and harvesting on Carwile soils if drainage outlets are available.

Conservation practices that control water erosion and soil blowing in areas used for dryland crops can also be applied to irrigated soils. These practices include terraces, contour farming, and minimum tillage systems that leave a protective cover of crop residue on the surface. The irrigation management system selected should be one that controls the application of irrigation water without wasting the water or eroding the soil. Gravity irrigation is the most efficient system if the correct stream size is used for each row and a tailwater recovery system is used to conserve the water. Sprinkler irrigation is most efficient on loamy and sandy soils and in undulating areas. Center-pivot sprinklers are effective in applying small amounts of water at frequent intervals.

Plants growing on soils disturbed during land leveling for irrigation respond to the application of phosphorus, zinc, and nitrogen, especially in areas where the topsoil has been removed.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c,* used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units," in the yields table, and in the section "Interpretive Groups."

Rangeland

H. Lynn Gibson, range conservationist, Soil Conservation Service, helped prepare this section.

About 42 percent of Kiowa County is rangeland. A great diversity of plant species makes up the native grassland in the county. Sandy soils are dominant north of U.S. Highway 54, and loamy soils are dominant south of the highway.

Most of the cattle enterprises are cow-calf operations; however, a number are yearling operations. Native grasses supply most of the forage but are commonly supplemented by milo stubble, wheat pasture, and other cropland forage. Hay and protein concentrates are common supplements in winter.

The soils strongly influence the potential native vegetation in the county. The texture of the surface layer and of the substratum affects the kind of vegetation. A high content of lime at the surface (fig. 13), salinity, and a seasonal high water table within a depth of 5 feet affect the kind and amount of forage species.

Range Sites and Condition Classes

Soils vary in their capacity to produce grasses and other plants for grazing. Soils that produce about the same kinds, amounts, and proportions of forage make up a range site.

The plant community in an area that is characterized by at least 75 percent climax vegetation is relatively stable and is indicative of what the site is capable of producing. Climax vegetation reproduces itself and changes in composition very little as long as the environment remains unchanged. The climax vegetation consists of the plants that grew on the prairie when the region was first settled. The most productive combination of forage plants on a range site generally is the climax vegetation.

Decreasers are plants in the climax vegetation that tend to decrease in a relative amount under close, continuous grazing. They generally are the tallest and most productive perennial grasses and forbs and are the most palatable to livestock.

Increasers are plants in the climax vegetation that increase in relative amount as the extent of the more desirable plants is reduced by close grazing. They generally are shorter than decreasers and are less palatable to livestock.

Invaders are plants that cannot compete with the climax plant community for moisture, nutrients, and light. Hence, they invade the site and grow along with increasers after the extent of the climax vegetation has been reduced by continuous heavy grazing. Invaders generally have little value for grazing.

Range condition is judged according to standards that apply to the particular range site. Four range condition classes are used to indicate the present condition of the native vegetation on a range site in relation to the native vegetation that could grow there. A range is in excellent condition if 76 to 100 percent of the vegetation is of the same kind as that in the climax stand; in good condition if the percentage is 51 to 75; in fair condition if the percentage is 26 to 50; and in poor condition if the percentage is 25 or less.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 6 shows, for nearly all the soils, the range site and the potential annual production of vegetation in favorable, average, and unfavorable years. An explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites

Figure 13.—Bluestem in an area of the Case soils. This grass is common on calcareous soils.

generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Potential annual production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Good range management keeps the range in excellent or good condition. Water is conserved, yields are improved, and the soils are protected. The main concern of management is recognizing the changes in plant cover that take place gradually and can be misinterpreted or overlooked. Growth resulting from heavy rainfall may lead to the conclusion that the range is in good condition when actually the cover is weedy and the long-term trend is toward lower production. On the other hand, some rangeland that has been closely grazed for a short period may have a degraded appearance that temporarily obscures its quality and ability to recover.

After years of prolonged overuse of rangeland, seed sources of desirable vegetation may have been eliminated. Brush control, range seeding, fencing, and development of watering facilities (fig.14) revitalize the stands of native plants. Thereafter, deferred grazing, proper grazing use, and a planned grazing system help to maintain or improve the range.

The soils in the survey area are assigned to the Blue Shale, Choppy Sands, Clay Terrace, Limy Upland, Loamy Lowland, Loamy Terrace, Loamy Upland, Loess Breaks, Saline Subirrigated, Sands, Sandy, Sandy Lowland, Sandy Terrace, Shallow Limy, Shallow Prairie, Shallow Sandstone, and Subirrigated range sites. These sites are described in the paragraphs that follow.

Blue Shale range site. Owens clay, 6 to 25 percent slopes, is in this range site. It is on uplands.

The potential native vegetation on this site is mixed prairie grasses. Typically, the dominant grasses are big bluestem, which makes up about 35 percent of the vegetation; little bluestem, 20 percent; sideoats grama, 15 percent; and indiangrass, 5 percent. Other grasses are blue grama, buffalograss, switchgrass, tall dropseed, and western wheatgrass. Forbs, such as dotted gayfeather, Illinois bundleflower, slimflower scurfpea, and upright prairie coneflower, make up about 5 percent of the vegetation. Leadplant, pricklypear, and small soapweed make up about 5 percent.

Initial overgrazing on this site generally reduces the production of big bluestem. Under these conditions, little bluestem becomes the dominant vegetation. After periods of continued overgrazing, western wheatgrass, blue grama, and buffalograss become the dominant species. Once this site is denuded by overgrazing or soil

Figure 14.—A stock-water excavated pond used to improve the distribution of grazing.

slippage, restoring productivity is difficult. Reseeding is difficult because of the slope and high clay content of the soil.

This site can generally be maintained near its potential or can be improved from a deteriorated condition by proper stocking rates and a planned grazing system. Less intensive grazing on the steeper slopes than in the more nearly level areas, which can be slightly overgrazed, commonly improves the site.

Choppy Sands range site. Tivoli fine sand, hilly, is in this range site. It is on uplands.

The potential native vegetation on this site is tall prairie grasses. Typically, the dominant grasses are sand bluestem, which makes up about 35 percent of the vegetation; little bluestem, 10 percent; indiangrass, 10 percent; switchgrass, 10 percent; and big sandreed, 10 percent. Other grasses are sand dropseed, sand paspalum, Texas bluegrass, blue grama, hairy grama, and sideoats grama. Forbs, such as lemon scurfpea, prairie sagewort, tenpetal blazingstar, western ragweed, and Virginia tephrosia, make up as much as 10 percent of the vegetation. Chickasaw plum, pricklypear, sand sagebrush, and small soapweed make up about 5 percent.

Overgrazing on this site results in decreased production of sand bluestem, switchgrass, little bluestem, and big sandreed. As the production of these species is reduced, the amount of sand dropseed, sand paspalum, blue and hairy grama, and sand sagebrush increases. If overuse continues, all tall grasses and most mid grasses are removed. Because of the susceptibility of the sandy surface layer to soil blowing, active dunes and blowouts generally form when the site deteriorates.

Because of the low available water capacity of the soil and poor management in the past, many areas in this range site are in poor condition. Maintaining the preferred species of grasses is difficult. A planned grazing system that includes proper stocking rates and periodic deferment of grazing during the growing season helps to maintain a permanent cover of vegetation. It also improves the condition of some of the desirable species. Deferring grazing for the entire grazing season or longer does not seem to be so effective in stabilizing the site as alternating grazing and rest periods within the grazing season.

Clay Terrace range site. New Cambria silty clay is in this range site. It is on stream terraces and is subject to rare flooding.

The potential native vegetation on this site is mixed prairie grasses. Typically, the dominant grasses are big bluestem, which makes up about 30 percent of the vegetation; little bluestem, 15 percent; indiangrass, 10 percent; switchgrass, 10 percent; and western wheatgrass, 10 percent. Other grasses are sideoats grama, blue grama, tall dropseed, and buffalograss. Forbs, such as heath aster, lambsquarters, Louisiana sagewort, bigtop dalea, Texas croton, and western ragweed, make up about 10 percent of the vegetation.

Partly because of additional water from adjacent sloping land, the production potential of this site is higher than that of similar soils on uplands. Continuous grazing during a wet spring or early summer may cause compaction, thus reducing the rate of water intake and restricting root development. If the site is continuously grazed during these wet periods or heavily grazed throughout the growing season, the taller grasses cannot easily survive.

After periods of overgrazing, buffalograss, blue grama, and western wheatgrass tend to dominate this site. Continuous overgrazing allows western ragweed, poverty sumpweed, little barley, and kochia to dominate the site. Once these plants are dominant, most of the taller grasses have been removed and returning the site to its production potential is difficult. Proper stocking rates and a flexible grazing system help to maintain the production potential or restore the site to near its potential.

Limy Upland range site. The soils in this range site are Case clay loam, 2 to 7 percent slopes; Case clay loam, 7 to 15 percent slopes; the Case soil in the Case-Canlon complex, 7 to 20 percent slopes; Clark loam, 1 to 3 percent slopes; Clark loam, 3 to 7 percent slopes; Coly silt loam, 4 to 9 percent slopes; and the Coly soil in the map unit Coly-Tobin silt loams, 0 to 20 percent slopes.

The potential native vegetation on this site is mixed prairie grasses. Typically, the dominant grasses are big bluestem, which makes up about 35 percent of the vegetation; little bluestem, 15 percent; sideoats grama, 15 percent; and blue grama, 10 percent. Other grasses are indiangrass, switchgrass, tall dropseed, western wheatgrass, buffalograss, and sand dropseed. Forbs, such as blacksamson, catclaw sensitivebrier, dotted gayfeather, heath aster, purple prairie-clover, slimflower scurfpea, and western ragweed, make up about 10 percent of the vegetation. Leadplant, pricklypear, and small soapweed grow in small amounts.

Big bluestem rapidly loses its productive capacity during periods of continuous overgrazing. As the production of big bluestem is reduced, the amount of little bluestem and sideoats grama initially increases. It decreases, however, during periods of continuous heavy grazing. The amount of blue grama and buffalograss increases as the amount of the taller grasses decreases. Continued excessive overuse results in a pasture of short grasses. Erosion forms gullies and cat steps on the steeper parts of the site if overuse is continued.

In the steeper, less accessible areas, the preferred grass species generally are not excessively grazed. These areas help to provide seed sources of the better forage plants after long periods of drought or overgrazing, or both. Grazing distribution is a problem because the livestock prefer the more gently sloping areas. Measures that distribute the grazing evenly, proper stocking rates, and a scheduled deferment of grazing during the growing season help to restore this site to its production potential. Properly locating salting and watering facilities helps to achieve an even distribution of grazing. Other management techniques, such as concentrated grazing and a planned grazing system, also are beneficial.

Loamy Lowland range site. The soils in this range site are the Tobin soil in the map unit Coly-Tobin silt loams, 0 to 20 percent slopes; Tobin silt loam, channeled; and Tobin silt loam, occasionally flooded. They are on flood plains and are frequently or occasionally flooded.

The potential native vegetation on this site is tall prairie grasses. Typically, the dominant grasses are big bluestem, which makes up about 40 percent of the vegetation; eastern gamagrass, 10 percent; indiangrass, 10 percent; and switchgrass, 10 percent. Other grasses are little bluestem, blue grama, prairie cordgrass, sideoats grama, tall dropseed, western wheatgrass, and red threeawn. Forbs, such as American licorice, catclaw sensitivebrier, Illinois bundleflower, Maximilian sunflower, pitcher sage, Baldwin ironweed, heath aster, Louisiana sagewort, and western ragweed, make up about 10 percent of the vegetation. American plum, Jersey tea, green ash, hackberry, indigobush, leadplant, and cottonwood make up about 5 percent.

Because of the extra moisture and deeper rooted plants, this site is a preferred grazing area, especially during plant stress periods. Overgrazing reduces the production of big bluestem, eastern gamagrass, indiangrass, switchgrass, and Canada wildrye. The amount of palatable forbs, such as American licorice, catclaw sensitivebrier, Illinois bundleflower, and Maximilian sunflower, is also reduced. Western wheatgrass, blue grama, red threeawn, tall dropseed, Baldwin ironweed, western ragweed, and scarlet globemallow are the principal increasers.

Where overgrazing has continued for a few years, the site can often be returned to near its potential by management that includes proper grazing use and a scheduled deferment of grazing during the growing season. If the site has been overgrazed for a long period, recovery may be slow even when good management is applied. Under these conditions, western wheatgrass generally becomes the dominant grass along with significant amounts of blue grama, tall dropseed, red threeawn, buffalograss, and sideoats grama.

Loamy Terrace range site. Dale silt loam is in this range site. It is on nearly level stream terraces and is subject to flooding.

The potential native vegetation on this site is mixed prairie grasses. Typically, the dominant grasses are big bluestem, which makes up about 40 percent of the vegetation; sideoats grama, 15 percent; little bluestem, 10 percent; and western wheatgrass, 10 percent. Other grasses are Canada wildrye, indiangrass, switchgrass, blue grama, buffalograss, sand dropseed, and tall dropseed. Forbs, such as American licorice, aromatic aster, catclaw sensitivebrier, heath aster, Illinois bundleflower, Louisiana sagewort, pitcher sage, slimflower scurfpea, and western ragweed, make up about 5 percent of the vegetation. Small amounts of American plum, pricklypear, and small soapweed are common.

This site is generally grazed along with larger areas of upland range sites. Because of the combination of sites, the careful use of management practices, such as fencing and the proper location of water, salt, minerals, and feeding areas, is needed to achieve an adequate distribution of grazing. After periods of continued excessive use, the amount of big bluestem, little bluestem, and sideoats grama decreases. Long-term overgrazing may remove these species from the site. Western wheatgrass is the major increaser on this site, along with forbs, blue grama, and buffalograss. Returning a continuously overgrazed area to its original productivity is difficult. In areas where remnant stands of the taller grasses are evident, proper stocking rates and periodic deferment of grazing or a planned grazing system help to return the site to near its potential. These practices also help to improve or maintain the site at any stage of productivity.

Loamy Upland range site. The soils in this range site are Farnum loam, 0 to 1 percent slopes; Farnum loam, 1 to 3 percent slopes; Harney silt loam, 0 to 1 percent slopes; Harney silt loam, 1 to 3 percent slopes; Holdrege silt loam, 0 to 1 percent slopes; Holdrege silt loam, 1 to 3 percent slopes; the Lancaster soil in the Lancaster-Hedville complex, 4 to 20 percent slopes; the Woodward soil in the map unit Quinlan-Woodward loams, 6 to 25 percent slopes; and Uly silt loam, 3 to 7 percent slopes.

The potential native vegetation on this site is mixed prairie grasses. Typically, the dominant grasses are big bluestem, which makes up about 20 percent of the vegetation; sideoats grama, 15 percent; western wheatgrass, 15 percent; and blue grama, 10 percent. Other grasses are indiangrass, little bluestem, buffalograss, sand dropseed, switchgrass, tall dropseed, Canada wildrye, red threeawn, and Scribner panicum. Forbs, such as western ragweed, Louisiana sagewort, slimflower scurfpea, dotted gayfeather, daisy fleabane, heath aster, and scarlet globemallow, make up about 15 percent of the vegetation. Leadplant is common on this site but generally in small amounts.

Initial overgrazing on this site generally reduces the production of big bluestem and little bluestem. Under these conditions, sideoats grama and blue grama become the dominant vegetation. After periods of continued overgrazing, blue grama, buffalograss, and lesser amounts of western wheatgrass become the dominant species. Once blue grama and buffalograss are dominant, the proportions of blue grama to buffalograss are determined by grazing pressure and weather cycles. After continued heavy grazing combined with long dry cycles, buffalograss tends to become dominant. If grazing is moderate, blue grama generally dominates. Only destructive grazing removes the buffalograss and blue grama from the site.

Once most of the taller species are removed from the site through grazing pressure and dry weather cycles, returning the site to its potential native vegetation is extremely difficult and may take several decades. Where remnant stands of the taller species are evident, the site can be returned to its production potential by proper stocking rates and a system of grazing that includes a scheduled deferment of grazing during the growing season. Maintaining significant amounts of big bluestem and little bluestem is difficult without a grazing management plan that includes rest periods.

Loess Breaks range site. Coly silt loam, 20 to 40 percent slopes, is in this range site. It is on uplands.

The potential native vegetation on this site is mixed prairie grasses. Typically, the dominant grasses are little bluestem, which makes up about 35 percent of the vegetation; big bluestem, 15 percent; and sideoats grama, 10 percent. Other grasses are switchgrass, western wheatgrass, blue grama, buffalograss, hairy grama, plains muhly, sand dropseed, tall dropseed, and red threeawn. Forbs, such as blacksamson, catclaw sensitivebrier, dotted gayfeather, heath aster, slimflower scurfpea, and western ragweed, make up about 5 percent of the vegetation. Jersey tea, leadplant, sand sagebrush, and small soapweed make up about 5 percent.

The site is not a preferred grazing area because of the slope. The majority of the grazing is on adjacent sites that are more gently sloping. When this site is excessively grazed, however, erosion may be greatly accelerated. After periods of excessive overgrazing, the amount of big bluestem, little bluestem, and sideoats grama is generally reduced and the amount of dropseed, threeawn, and hairy grama increases.

Grazing management that includes proper stocking rates for the entire grazing unit is generally all that is needed to improve or maintain the present condition. A scheduled deferment of grazing or a planned grazing system improves the site more rapidly. A combination of concentrated grazing and needed rest periods can be very beneficial.

Saline Subirrigated range site. Krier sandy loam, occasionally flooded, is in this range site. It is on bottom land. It generally is wet throughout the spring and early summer.

The potential native vegetation on this site is mixed prairie grasses of mostly salt-tolerant species. Typically, the dominant grasses are alkali sacaton, which makes up about 25 percent of the vegetation; switchgrass, 20 percent; alkali cordgrass, 10 percent; inland saltgrass, 10 percent; and tall dropseed, 10 percent. Other grasses are western wheatgrass, blue grama, buffalograss, sand dropseed, Scribner panicum, indiangrass, and red threeawn. Forbs, such as heath aster, Pennsylvania smartweed, purple prairie-clover, and western ragweed, make up about 10 percent of the vegetation. Willow baccharis grows in small amounts.

Overgrazing on this site has little effect on species composition unless the overgrazing is excessive over a long period. The small amounts of indiangrass and switchgrass, however, can easily be reduced by overgrazing. Excessive use can reduce the productivity of the site by reducing the vigor of the grasses and by increasing the amount of inland saltgrass at the expense of the taller species.

Proper stocking rates and timely grazing help to maintain this site in a productive condition. Grazing early in the growing season is important because the species tolerant of saline-alkali conditions tend to mature rapidly and become much less palatable late in the season. Periodic deferment of grazing helps to maintain the productivity and vigor of the dominant grasses.

Sands range site. The soils in this range site are Pratt loamy fine sand, undulating; Pratt loamy fine sand, rolling; and Pratt-Tivoli loamy fine sands, rolling.

The potential native vegetation on this site is tall prairie grasses. Typically, the dominant grasses are sand bluestem, which makes up about 30 percent of the vegetation; little bluestem, 15 percent; big sandreed, 10 percent; and sand lovegrass, 10 percent. Other grasses are indiangrass, sideoats grama, switchgrass, blue grama, sand dropseed, sand paspalum, Scribner panicum, and western wheatgrass. Forbs, such as Engelmann-daisy, lemon scurfpea, Louisiana sagewort, prairie sunflower, silktop dalea, silky prairie-clover, tenpetal blazingstar, and western ragweed, make up about 10 percent of the vegetation. Chickasaw plum, sand sagebrush, pricklypear, and small soapweed make up about 10 percent.

Soils that have a loamy fine sand surface soil take in water rapidly and release it readily to plants. As a result, the taller species can adapt to areas of restricted rainfall. Sand bluestem generally is the dominant plant on this site but is partly replaced by sideoats grama, little bluestem, blue grama, and sand dropseed during extended dry periods.

Overgrazing on this site rapidly reduces the production of sand bluestem. After periods of continued overgrazing, the amount of sideoats grama, little bluestem, sand lovegrass, switchgrass, and Engelmann-daisy is reduced. In some areas the vegetation has deteriorated to sand dropseed, sand sagebrush, small soapweed, prickly-pear, and lesser amounts of unpalatable forbs and grasses.

Management that includes proper grazing use and a scheduled deferment of grazing during the growing season is essential to maintain the productivity of this site. These practices and favorable climatic conditions can rapidly restore the site to its production potential if sufficient remnants of the original plant community are on the site.

Sandy range site. The soils in this range site are Albion sandy loam, 1 to 4 percent slopes; Albion-Shellabarger sandy loams, 4 to 15 percent slopes; Attica loamy fine sand, 1 to 4 percent slopes; the Attica-Carwile complex, 0 to 4 percent slopes; Carwile fine sandy loam; Naron fine sandy loam, 0 to 1 percent slopes; Naron fine sandy loam, 1 to 3 percent slopes; and Shellabarger loam, 2 to 6 percent slopes. These soils are on uplands.

The potential native vegetation on this site is mixed prairie grasses. Typically, the dominant grasses are little bluestem, which makes up about 20 percent of the vegetation; sand or big bluestem, 15 percent; switchgrass, 10 percent; sideoats grama, 10 percent; and blue grama, 10 percent. Other grasses are sand lovegrass, buffalograss, sand dropseed, western wheatgrass, big sandreed, sand paspalum, and Scribner panicum. Forbs, such as Louisiana sagewort, poppymallow, slimflower scurfpea, upright prairie coneflower, western ragweed, and yarrow make up about 10 percent of the vegetation. Chickasaw plum, sand sagebrush, and small soapweed make up about 5 percent.

This site generally is a highly preferred grazing area. Because of past grazing management, it is generally more deteriorated than most of the adjacent sites. Overgrazing rapidly reduces the production of big or sand bluestem. The bluestems are generally replaced by sideoats grama, blue grama, and sand dropseed. If overgrazing continues, the amount of little bluestem, switchgrass, and sand lovegrass is reduced. After long periods of severe overgrazing, the site is dominated by sand dropseed, sand paspalum, annual grasses, unpalatable forbs, and woody species.

Management that includes proper grazing use and a scheduled deferment of grazing during the growing season maintains this site in a productive condition. Also, it can restore overgrazed areas to their original production potential if remnants of the original species are evident. Reseeding may be needed on sites where the more desirable mid and tall grasses have been removed.

Sandy Lowland range site. Lincoln sandy loam, occasionally flooded, is in this range site. It is on flood plains adjacent to stream channels. It generally occurs as long, narrow areas rather than extensive areas. As a result, managing the range site by itself is difficult.

The potential native vegetation on this site is tall prairie grasses. Typically, the dominant grasses are sand bluestem, which makes up about 30 percent of the vegetation; little bluestem, 15 percent; indiangrass, 10 percent; and switchgrass, 10 percent. Other grasses are big sandreed, Canada wildrye, sand lovegrass, sideoats grama, western wheatgrass, blue grama, sand dropseed, and tall dropseed. Forbs, such as catclaw sensitivebrier, Engelmann-daisy, heath aster, Illinois bundleflower, Maximilian sunflower, Louisiana sagewort, and western ragweed, make up about 10 percent of the vegetation. Chickasaw plum, cottonwood, sandbar willow, sand sagebrush, and small soapweed make up about 5 percent.

Initial overgrazing on this site reduces the production of the bluestems. As the production of these species decreases, the amount of western wheatgrass increases. To a small extent, the amount of threeawn and dropseed also increases. If overgrazing continues, kochia, Russian-thistle, and other undesirable annuals invade the site.

Once most of the taller species are removed from the site through grazing pressure and dry weather cycles, restoring the potential native vegetation is difficult. Where remnants of the taller species are evident, management that includes proper stocking rates and a scheduled deferment of grazing during the growing season is effective in restoring the site to near its potential.

Sandy Terrace range site. Canadian fine sandy loam is in this range site. It is on stream terraces.

The potential native vegetation on this site is tall prairie grasses. Typically, the dominant grasses are sand and big bluestems, which make up about 25 percent of the vegetation; switchgrass, 15 percent; indiangrass, 15 percent; and little bluestem, 10 percent. Other grasses are big sandreed, Canada wildrye, sand lovegrass, sideoats grama, western wheatgrass, blue grama, sand dropseed, and tall dropseed. Forbs, such as catclaw sensitivebrier, Engelmann-daisy, heath aster, Illinois bundleflower, Maximilian sunflower, Louisiana sagewort, and western ragweed, make up about 10 percent of the vegetation. Chickasaw plum, cottonwood, sand sagebrush, and small soapweed make up about 5 percent.

Initial overgrazing on this site reduces the production of the bluestems. As the production of these species is reduced, the amount of western wheatgrass and dropseed increases. To a small extent, the amount of threeawn, sand sagebrush, and yucca also increases. After western wheatgrass and dropseed are dominant, continued overgrazing results in the invasion of kochia, Russian-thistle, and other undesirable annuals.

Once most of the taller species are removed from the site through grazing pressure and weather cycles, restoring the potential native vegetation is difficult. Where remnants of the taller species are evident, management that includes proper stocking rates and a scheduled deferment of grazing during the growing season helps to restore the site to near its potential.

Shallow Limy range site. The Canlon soil in the Case-Canlon complex, 7 to 20 percent slopes, is in this range site. It is on uplands.

The potential native vegetation on this site is mixed prairie grasses. Typically, the dominant grasses are little bluestem, which makes up about 35 percent of the vegetation; big bluestem, 25 percent; and sideoats grama, 10 percent. Other grasses are indiangrass, switchgrass, blue grama, buffalograss, hairy grama, plains muhly, and tall dropseed. Forbs, such as blacksamson, catclaw sensitivebrier, dotted gayfeather, Louisiana sagewort, slimflower scurfpea, and western ragweed, make up about 15 percent of the vegetation. Small amounts of fragrant sumac, leadplant, pricklypear, and smooth sumac are common.

Much of the site is steep and has rock ledges forming vertical drops. Most of the more nearly level areas, generally just above the break of the hills, are grazed rather heavily, and the rougher areas are grazed less extensively. The rougher areas, however, commonly support the better forage plants.

If this site is excessively grazed, big bluestem is rapidly replaced by little bluestem and sideoats grama. If excessive grazing continues, little bluestem and sideoats grama are replaced by blue grama, hairy grama, buffalograss, red threeawn, and less palatable perennial and annual forbs.

Properly locating areas where salt, water, and minerals are available improves the distribution of grazing on this site. Livestock trails that allow access to all parts of the site may be needed before an optimum distribution of grazing can be achieved. Because of the protection afforded by the rough topography and rocks, grazing systems and improved management that includes proper stocking rates can rapidly restore the site to near its potential in most areas.

Shallow Prairie range site. The Quinlan soil in the map unit Quinlan-Woodward loams, 6 to 25 percent slopes, is in this range site. It is on uplands.

The potential native vegetation on this site is mixed prairie grasses. Typically, the dominant grasses are little bluestem, which makes up about 30 percent of the vegetation; big and sand bluestem, 15 percent; sideoats grama, 10 percent; and indiangrass, 5 percent. Other grasses are blue grama, buffalograss, hairy grama, sand dropseed, red threeawn, and switchgrass. Forbs, such as dotted gayfeather, white and purple prairie-clover, slimflower scurfpea, Louisiana sagewort, and western ragweed, make up about 10 percent of the vegetation.

Big and sand bluestems rapidly lose their productive capacity during periods of continuous overgrazing. As the production of these species is reduced, the amounts of little bluestem and sideoats grama initially increases. It decreases, however, during periods of continuous heavy grazing. The amount of blue grama and buffalograss increases as the amount of the taller grasses decreases. Continued excessive overuse results in a pasture of short grasses.

In the steeper, less accessible areas, the preferred grass species generally are not excessively grazed. These areas help to provide seed sources of the better forage plants after long periods of drought or overgrazing, or both. Grazing distribution is a problem because the livestock prefer the more gently sloping areas. Measures that distribute the grazing evenly, proper stocking rates, and a scheduled deferment of grazing during the growing season help to restore this site to its production potential. Properly locating salting and watering facilities helps to achieve an even distribution of grazing. Other management techniques, such as concentrated grazing and a planned grazing system, also are beneficial.

Shallow Sandstone range site. The Hedville soils in the Hedville-Rock outcrop complex, 15 to 30 percent slopes, and in the Lancaster-Hedville complex, 4 to 20 percent slopes, are in this range site. These soils are on uplands.

The potential native vegetation on this site is mixed prairie grasses. Typically, the dominant grasses are little bluestem, which makes up about 35 percent of the vegetation; big bluestem, 25 percent; sideoats grama, 10 percent; indiangrass, 5 percent; and switchgrass, 5 percent. Other grasses are blue grama, buffalograss, sand dropseed, tall dropseed, and red threeawn. Forbs, such as dotted gayfeather, white and purple prairie-clover, slimflower scurfpea, Louisiana sagewort, and western ragweed, make up about 10 percent of the vegetation.

Where grazing pressure is excessive, the production of big bluestem is rapidly reduced and this grass is replaced by sideoats grama and lesser amounts of blue grama and buffalograss. After periods of continued overgrazing, big bluestem, little bluestem, and sideoats grama are replaced by blue grama, buffalograss, hairy grama, and sand dropseed. Grazing pressure is rarely heavy enough to remove the better grasses from the site. Proper stocking rates and a scheduled deferment of grazing during the growing season help to maintain the production potential or restore the site to near its potential.

Subirrigated range site. Plevna loam, frequently flooded, and Waldeck loam, occasionally flooded, are in this range site. They are on flood plains.

The potential native vegetation on this site is tall prairie grasses. Typically, the dominant grasses are big bluestem, which makes up about 25 percent of the vegetation; eastern gamagrass, 20 percent; switchgrass, 10 percent; indiangrass, 5 percent; and prairie cordgrass, 5 percent. Numerous other grasses and grasslike plants make up about 15 percent of the vegetation. Forbs, such as American licorice, Illinois bundleflower, Maximilian sunflower, wholeleaf rosinweed, and goldenrod, make up about 15 percent. Almondleaf willow, black willow, common buttonbush, cottonwood, indigobush and willow baccharis make up about 5 percent.

Because of the availability of water, the vegetation on this site remains lush and green throughout the growing season. Because the lush vegetation attracts grazing animals, special management techniques are needed to prevent overgrazing.

When degeneration of the vegetative composition results from overgrazing, big bluestem, eastern gamagrass, indiangrass, switchgrass, and prairie cordgrass are the primary decreasers. Palatable forbs, including Maximilian sunflower, wholeleaf rosinweed, Illinois bundleflower, and sessileleaf tickclover, also decrease in abundance. The principal increasers include western wheatgrass, meadow dropseed, tall dropseed, alkali sacaton, American bulrush, goldenrod, and woody plants. Continued deterioration of the plant community results in an increased production of the shorter plants, such as sideoats grama, blue grama, inland saltgrass, buffalograss, western ragweed, and heath aster.

In the absence of fire or grazing by livestock, the vegetation gradually deteriorates to heavy stands of woody plants, such as cottonwood, willow, elm, dogwood, and locust. The understory in these stands consists of sparse amounts of Virginia wildrye, green muhly, Texas bluegrass, Kentucky bluegrass, and Scribner panicum.

Grazing management that maintains or improves this site should include proper stocking rates. A planned grazing system or a scheduled deferment of grazing is needed, especially in areas where other range sites are included in the grazing unit. Controlled burning is very helpful in maintaining high quality forage on the site. It also helps to control woody species and removes the excess growth from lightly used areas.

Native Woodland, Windbreaks, and Environmental Plantings

Keith A. Ticknor, forester, Soil Conservation Service, helped prepare this section.

Wooded areas other than windbreaks in Kiowa County are limited to narrow bands along the major streams and to scattered trees or clumps of trees on shallow soils in the Owens-Lancaster-Quinlan soil association.

Eastern cottonwood, peachleaf willow, and black willow make up the greatest percentage of the trees along the streams. In addition, some areas support significant numbers of hackberry, green ash, black walnut, American elm, and Russian mulberry. The bands of trees are not always continuous along the streams. For example, some areas along Rattlesnake Creek are heavily wooded, whereas other areas support no trees. Also, the band of trees along Thompson Creek ends at a point where the soils change from Plevna to Lincoln.

Eastern redcedar is plentiful in areas in the southeastern part of the county where the soils are shallow to sandstone. In association with the cedar, American elm and green ash are in channels of the drainageways.

Commercial use of the small amount of woodland for wood products is very limited. The trees on bottom land along the streams have potential for the production of sawtimber, firewood, and other wood products. This land, however, is committed to other uses and is unlikely to be converted to forest land. The existing woodland is used locally for numerous wood products.

Trees grow around most of the ranch headquarters and farmsteads in Kiowa County. They were planted at various times by the landowners after the headquarters were established. Siberian elm and eastern redcedar are the most common species of trees in these windbreaks. Other species, such as green ash, hackberry, lilac, ponderosa pine, Austrian pine, and oriental arborvitae, have also been planted.

Tree planting around the farmstead is a continuing need because old trees pass maturity and deteriorate, because some trees are destroyed by insects, disease, or storms, and because new plantings are needed on expanding farmsteads. Supplemental planting is needed in many of these windbreaks to reinforce them and to restore their effectiveness in controlling wind and snow.

Many field windbreaks or shelterbelts are established throughout the county, especially in areas of the Pratt-Tivoli, Pratt-Attica, and Farnum-Naron soil associations. The shelterbelts vary widely in size, row arrangement, and species. Some are made up of as many as 14 rows of trees and shrubs. The species in these windbreaks include eastern redcedar, American plum, Siberian elm, eastern cottonwood, Russian mulberry, ponderosa pine, black locust, honeylocust, green ash, hackberry, black walnut, bur oak, Russian-olive, osageorange, lilac, northern catalpa, and fragrant sumac. Some of these windbreaks have been partially or totally removed to accommodate center-pivot irrigation.

In order for windbreaks to fulfill their intended purpose, the soils on the site should be suited to the trees or shrubs selected for planting. Matching the soil type with the proper tree species is the first step toward ensuring survival and a maximum growth rate. Permeability, available water capacity, fertility, soil texture and depth, and drainage greatly affect the growth rate.

Establishing trees and shrubs is difficult in Kiowa County because moisture is limited. The main management needs are proper site preparation before the trees or shrubs are planted and measures that control competing weeds and grasses after the trees and shrubs are planted. Supplemental watering is necessary to provide moisture during periods when the windbreak is becoming established.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

Kiowa County has several areas of scenic, geologic, and historic interest. The Big Well, a hand-dug well 32 feet in diamater and 109 feet deep, is located in Greensburg. It was completed in 1888 by the Santa Fe Railroad. The county is geologically diverse, having undulating sandy areas; rough, steep areas of sandstone; and areas that are relatively flat. The rural landscape is quite scenic. The rolling grasslands and wooded streams add beauty and variety to the landscape. Farm ponds and the Kiowa State Fishing Lake provide opportunities for water sports. The hunting seasons for pheasant, quail, and deer attract sportsmen from long distances. The potential for additional recreational development within the county is good.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

The primary game species in Kiowa County are ringneck pheasant, bobwhite quail, mourning dove, and white-tailed and mule deer. Several species of waterfowl and the Rio Grande turkey also are hunted. A few prairie chickens and antelopes inhabit the county.

Nongame species are numerous because of the many habitat types in the county. Cropland, woodland, and grassland are interspersed throughout the county. Each of these provides a habitat for a particular group of species.

Furbearers inhabit areas along the streams. They are trapped on a limited basis.

Trees and shrubs along streams and in windbreaks provide permanent cover for many wildlife species. The section "Native Woodland, Windbreaks, and Environmental Plantings" provides information about establishing trees and shrubs.

Stock water ponds and Kiowa State Fishing Lake provide good or fair fishing. The species commonly caught are largemouth bass, bluegill, channel cat, and bullhead catfish.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, grain sorghum, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestems, grama grasses, switchgrass, indiangrass, wheatgrass, goldenrod, broomweed, ragweed, sunflower, and native legumes.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of native shrubs are plum, dogwood, buckbrush, prairie rose, and sumac.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, cattail, indigobush, saltgrass, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, mourning dove, pheasant, meadowlark, field sparrow, and cottontail rabbit.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, redwing blackbirds, muskrat, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include coyotes, jackrabbits, mule deer, prairie dogs, antelopes, prairie chickens, killdeer, and meadowlarks.

Technical assistance in planning wildlife areas and in determining the vegetation suitable for planting can be obtained from the local office of the Soil Conservation Service. Additional information and assistance can be obtained from the Kansas Fish and Game Commission and from the Cooperative Extension Service.

Engineering

John Eberwein, civil engineer, Soil Conservation Service, helped prepare this section.

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Sanitary Facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 17.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 15). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

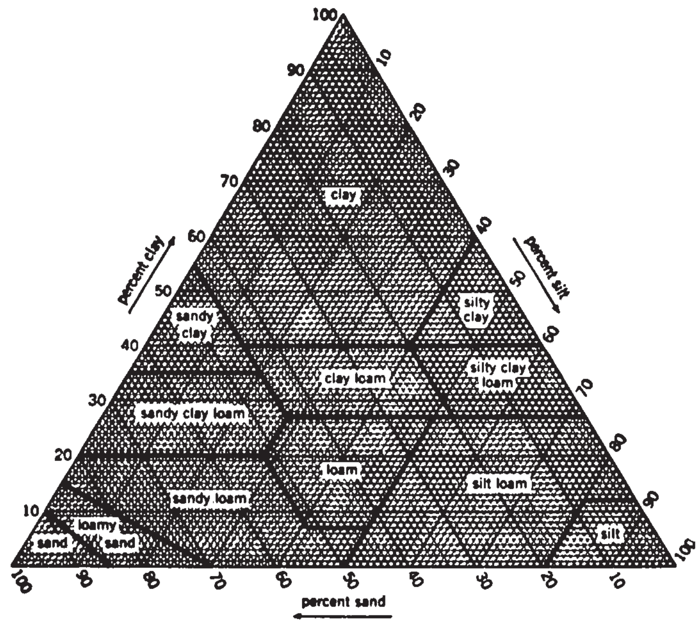

Figure 15.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to absorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Index Test Data

Table 17 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the Kansas Department of Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*7*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (*Ust*, meaning intermittent dryness, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplustolls (*Hapl*, meaning minimal horizonation, plus *ustoll*, the suborder of the Mollisols that have an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Typic Haplustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*6*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*7*). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Albion Series

The Albion series consists of deep, somewhat excessively drained soils on uplands. These soils formed in loamy sediments that are 20 to 40 inches deep over sandy alluvium. Permeability is moderately rapid in the solum and rapid in the substratum. Slope ranges from 1 to 15 percent.

Albion soils are similar to Attica and Canadian soils and are commonly adjacent to Case, Clark, and Shellabarger soils. Attica and Canadian soils have finer sand in the subsoil and substratum than the Albion soils. Case, Clark, and Shellabarger soils have a subsoil that is more clayey than that of the Albion soils. Also, they are higher on the landscape.

Typical pedon of Albion sandy loam, 1 to 4 percent slopes, 2,290 feet south and 2,490 feet west of the northeast corner of sec. 3, T. 29 S., R. 17 W.

A—0 to 11 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable; many fine roots; slightly acid; clear smooth boundary.

Bt1—11 to 17 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable; common fine roots; slightly acid; gradual smooth boundary.

Bt2—17 to 24 inches; brown (7.5YR 5/4) sandy loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable; few fine roots; slightly acid; gradual smooth boundary.

2C—24 to 60 inches; light yellowish brown (10YR 6/4) sand, yellowish brown (10YR 5/4) moist; single grained; loose; neutral.

The thickness of the solum and the depth to sand or sand and gravel range from 20 to 40 inches. The content of gravel in the solum ranges from 0 to 15 percent.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is slightly acid or medium acid. The Bt horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It ranges from slightly acid to mildly alkaline. The 2C horizon has hue of 10YR or 7.5YR, value of 4 to 6 (4 or 5 moist), and chroma of 3 to 6. It is loamy sand, coarse sand, or gravelly sand. It ranges from slightly acid to moderately alkaline.

Attica Series

The Attica series consists of deep, well drained, moderately rapidly permeable soils on uplands. These soils formed in loamy eolian deposits. Slope ranges from 1 to 4 percent.

Attica soils are similar to Albion, Canadian, Naron, and Pratt soils and are commonly adjacent to Carwile, Farnum, Naron, and Pratt soils. The somewhat excessively drained Albion soils have a sandy substratum. Canadian soils do not have an argillic horizon. The somewhat poorly drained Carwile soils have a clayey subsoil and are in depressions. Farnum and Naron soils have a subsoil that is more clayey than that of the Attica soils. Also, they are lower on the landscape. Pratt soils have a subsoil that is sandier than that of the Attica soils. Also, they are higher on the landscape.

Typical pedon of Attica loamy fine sand, 1 to 4 percent slopes, 2,540 feet north and 175 feet east of the southwest corner of sec. 1, T. 28 S., R. 18 W.

Ap1—0 to 7 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable; many fine roots; slightly acid; abrupt smooth boundary.

Ap2—7 to 10 inches; pale brown (10YR 6/3) loamy fine sand, dark brown (10YR 3/3) moist; weak thick platy structure parting to weak fine granular; soft, very friable; many fine roots; slightly acid; abrupt smooth boundary.

BA—10 to 15 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable; many fine roots; slightly acid; clear smooth boundary.

Bt—15 to 30 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable; clay bridges between sand grains; slightly acid; gradual smooth boundary.

C—30 to 60 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; massive; soft, very friable; neutral.

The thickness of the solum ranges from 22 to 50 inches. The A horizon has hue of 10YR, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. It is dominantly loamy fine sand, but the range includes fine sandy loam. This horizon is slightly acid or neutral. The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6 (4 or 5 moist), and chroma of 2 to 4. The C horizon has hue of 10YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 to 6. It is fine sandy loam or loamy fine sand. Silty or more clayey strata that contain lime are below a depth of 40 inches in some pedons.

Canadian Series

The Canadian series consists of deep, well drained, moderately rapidly permeable soils on stream terraces. These soils formed in loamy alluvium. Slope ranges from 0 to 2 percent.

Canadian soils are similar to Albion and Attica soils and are commonly adjacent to Lincoln, Plevna, and Waldeck soils. Albion and Attica soils have an argillic horizon. Lincoln, Plevna, and Waldeck soils are on flood plains. The somewhat excessively drained Lincoln soils have a sandy subsoil. Plevna soils are poorly drained, and Waldeck soils are somewhat poorly drained.

Typical pedon of Canadian fine sandy loam, 1,590 feet east and 2,465 feet north of the southwest corner of sec. 10, T. 29 S., R. 17 W.

A—0 to 14 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; many fine roots; neutral; gradual smooth boundary.

Bw—14 to 30 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak fine granular structure; slightly hard, friable; common fine roots; neutral; gradual smooth boundary.

C—30 to 60 inches; yellowish brown (10YR 5/4) fine sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable; common fine roots decreasing in abundance with increasing depth; neutral.

The thickness of the solum ranges from 20 to 40 inches. The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is slightly acid or neutral. The Bw horizon has hue of 10YR or 7.5YR, value of 4 or 5 (3 or 4 moist), and chroma of 2 to 4. It is slightly acid or neutral. The C horizon has hue of 10YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 or 4. It ranges from slightly acid to mildly alkaline. Some pedons are loamy fine sand below a depth of 40 inches.

Canlon Series

The Canlon series consists of shallow, well drained, moderately permeable soils on uplands. These soils formed in material weathered from caliche. Slope ranges from 7 to 20 percent.

Canlon soils are commonly adjacent to Case, Clark, and Owens soils. Case and Clark soils are more than 40 inches deep over bedrock. Case soils are in landscape positions similar to those of the Canlon soils. Clark soils are in the less sloping areas. Owens soils are clayey. They are on the lower slopes.

Typical pedon of Canlon loam, in an area of Case-Canlon complex, 7 to 20 percent slopes, 2,000 feet west and 350 feet south of the northeast corner of sec. 11, T. 30 S., R. 18 W.

A—0 to 5 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, friable; many fine and medium roots; violent effervescence; moderately alkaline; clear smooth boundary.

AC—5 to 10 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak medium granular structure; slightly hard, friable; many fine and medium roots; few small caliche fragments; violent effervescence; moderately alkaline; clear smooth boundary.

C—10 to 14 inches; light gray (10YR 7/2) loam, brown (10YR 5/3) moist; massive; slightly hard, friable; common fine roots; common fine caliche fragments; violent effervescence; moderately alkaline; abrupt wavy boundary.

R—14 inches; hard caliche.

The thickness of the solum ranges from 3 to 12 inches. The depth to caliche bedrock ranges from 10 to 20 inches. The content of caliche fragments less than 3 inches in diameter ranges from 0 to 25 percent throughout the profile.

The A horizon has hue of 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3. The C horizon has hue of 10YR, value of 6 to 8 (4 to 7 moist), and chroma of 2 to 4. It is loam or gravelly loam.

Carwile Series

The Carwile series consists of deep, somewhat poorly drained, slowly permeable soils on broad, slightly depressional uplands. These soils formed in old alluvium. Slope is 0 to 1 percent.

Carwile soils are commonly adjacent to Attica, Farnum, Naron, and Pratt soils. All the adjacent soils are well drained. They have a subsoil that is less clayey than that of the Carwile soils. Also, they are higher on the landscape.

Typical pedon of Carwile fine sandy loam, 225 feet east and 125 feet south of the northwest corner of sec. 24, T. 27 S., R. 17 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; medium acid; abrupt smooth boundary.

A—6 to 15 inches; gray (10YR 5/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak medium granular structure; slightly hard, friable; slightly acid; gradual smooth boundary.

Bt—15 to 36 inches; gray (10YR 6/1) clay, dark gray (10YR 4/1) moist; moderate medium blocky structure; very hard, firm; thick continuous clay films; neutral; gradual smooth boundary.

BC—36 to 50 inches; light brownish gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; weak coarse blocky structure; very hard, firm; few soft accumulations of lime; mildly alkaline; gradual smooth boundary.

C—50 to 60 inches; light brownish gray (2.5Y 6/2) clay, olive gray (5Y 5/2) moist; few medium distinct light olive brown (2.5Y 5/4) mottles; massive; hard, firm; common fine lime concretions and soft accumulations of lime; moderately alkaline.

The thickness of the solum ranges from 30 to 60 inches. The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly fine sandy loam, but the range includes loamy fine sand. This horizon ranges from medium acid to neutral. The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 1 or 2. It is clay or clay loam. It ranges from slightly acid to mildly alkaline. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 4. It is sandy clay loam or clay.

Case Series

The Case series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in calcareous, loamy old alluvium. Slope ranges from 2 to 15 percent.

Case soils are similar to Clark soils and are commonly adjacent to Albion, Canlon, Clark, and Owens soils. The noncalcareous Albion soils contain less clay in the subsoil than the Case soils. Also, they are lower on the landscape. Canlon soils are 10 to 20 inches deep over caliche. They are on slopes above the Case soils. Clark soils have a mollic epipedon. Owens soils are clayey and are 10 to 20 inches deep over shale. They are below the Case soils on the landscape.

Typical pedon of Case clay loam, 2 to 7 percent slopes, 2,065 feet west and 150 feet north of the southeast corner of sec. 30, T. 30 S., R. 17 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; common fine lime concretions; strong effervescence; moderately alkaline; abrupt smooth boundary.

Bw—6 to 18 inches; light brownish gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; weak coarse subangular blocky structure parting to moderate medium granular; hard, friable; many medium rounded lime concretions; few fine soft accumulations of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

Bk—18 to 26 inches; very pale brown (10YR 7/3) clay loam, pale brown (10YR 6/3) moist; common medium distinct reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; very hard, firm; some light brownish gray (10YR 6/2) ped faces; common fine soft accumulations of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C—26 to 60 inches; very pale brown (10YR 7/3) clay loam, pale brown (10YR 6/3) moist; massive; hard, friable; common medium soft accumulations of lime; strong effervescence; moderately alkaline.

The soils are calcareous and mildly alkaline or moderately alkaline throughout. The A horizon has hue of 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3. It is dominantly clay loam, but the range includes loam and fine sandy loam. The Bw and C horizons have hue of 10YR, 7.5YR, or 5YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. They are clay loam or loam.

Clark Series

The Clark series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in calcareous, loamy old alluvium. Slope ranges from 1 to 7 percent.

Clark soils are similar to Case soils and are commonly adjacent to Albion, Case, and Harney soils. The noncalcareous Albion soils contain less clay in the subsoil than the Clark soils. Also, they are lower on the landscape. Case soils do not have a mollic epipedon. Harney soils have a silty subsoil. They are on the higher parts of the landscape.

Typical pedon of Clark loam, 1 to 3 percent slopes, 800 feet north and 75 feet east of the southwest corner of sec. 9, T. 29 S., R. 17 W.

Ap—0 to 5 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; hard, friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

A—5 to 10 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; hard, friable; strong effervescence; moderately alkaline; clear smooth boundary.

Bw—10 to 15 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to weak medium subangular blocky; hard, friable; few worm casts; violent effervescence; few small rounded carbonate concretions; moderately alkaline; clear smooth boundary.

Bk—15 to 34 inches; light yellowish brown (10YR 6/4) clay loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; hard, firm; few worm casts; violent effervescence; many soft masses and threads of lime; few small rounded carbonate concretions; moderately alkaline; gradual smooth boundary.

C—34 to 60 inches; light yellowish brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; massive; hard, friable; violent effervescence; common soft masses and threads of lime; few small rounded carbonate concretions; moderately alkaline.

The soils are mildly alkaline or moderately alkaline loam or clay loam throughout. The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. The Bw horizon has hue of 10YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. The C horizon has hue of 10YR, 7.5YR, or 5YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 6.

Coly Series

The Coly series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in silty, calcareous loess. Slope ranges from 4 to 40 percent.

Coly soils are similar to Uly soils and are commonly adjacent to Harney, Holdrege, Tobin, and Uly soils. Harney and Holdrege soils have a subsoil that is more clayey than that of the Coly soils. Also, they are higher on the landscape. Tobin soils have a mollic epipedon that is more than 20 inches thick and are on flood plains. Uly soils have a mollic epipedon and are higher on the landscape than the Coly soils.

Typical pedon of Coly silt loam, 4 to 9 percent slopes, 1,500 feet north and 175 feet west of the southeast corner of sec. 11, T. 29 S., R. 18 W.

Ap—0 to 5 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak fine granular structure; slightly hard, friable; strong effervescence; few lime concretions; moderately alkaline; clear smooth boundary.

AC—5 to 12 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; weak fine granular structure; slightly hard, friable; strong effervescence; common fine spots of lime; few fine lime concretions; moderately alkaline; gradual smooth boundary.

C—12 to 60 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable; violent effervescence; common films and threads of lime; some root channels lined with lime; moderately alkaline.

The thickness of the solum ranges from 3 to 14 inches. Typically, lime is at the surface, but some pedons do not have lime in the upper 6 inches. The soils are mildly alkaline or moderately alkaline silt loam or loam throughout.

The A horizon has hue of 10YR, value of 5 to 7 (3 to 5 moist), and chroma of 2 or 3. The AC and C horizons have hue of 10YR or 7.5YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3.

Dale Series

The Dale series consists of deep, well drained, moderately permeable soils on stream terraces. These soils formed in silty alluvium. Slope ranges from 0 to 2 percent.

Dale soils are similar to Tobin soils and are commonly adjacent to Lincoln, Plevna, Tobin, and Waldeck soils. The adjacent soils are on flood plains. The somewhat excessively drained Lincoln soils are sandy. The poorly drained Plevna soils and the somewhat poorly drained Waldeck soils have a loamy subsoil. Tobin soils are frequently flooded or occasionally flooded.

Typical pedon of Dale silt loam, 1,300 feet south and 200 feet east of the northwest corner of sec. 33, T. 30 S., R. 19 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; hard, friable; many fine roots; slightly acid; abrupt smooth boundary.

A—7 to 16 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; slightly hard, friable; many fine roots; neutral; clear smooth boundary.

Bw1—16 to 28 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; very hard, friable; many fine roots; mildly alkaline; gradual smooth boundary.

Bw2—28 to 34 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; very hard, firm; common fine roots; few threads and seams of lime; moderately alkaline; gradual smooth boundary.

C—34 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; hard, friable; moderately alkaline; strong effervescence.

The thickness of the mollic epipedon and the depth to lime range from 20 to 50 inches. The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. The Bw horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 to 4. It is silt loam or silty clay loam. It ranges from slightly acid to mildly alkaline. The C horizon has hue of 10YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 to 6. It is mildly alkaline or moderately alkaline.

Farnum Series

The Farnum series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loamy old alluvium. Slope ranges from 0 to 3 percent.

Farnum soils are similar to Naron soils and are commonly adjacent to Carwile, Naron, and Shellabarger soils. The somewhat poorly drained Carwile soils have a clayey subsoil and are in depressions. Naron and Shellabarger soils contain less clay in the subsoil than the Farnum soils. Also, Naron soils are higher on the landscape, and Shellabarger soils are lower on the landscape.

Typical pedon of Farnum loam, 1 to 3 percent slopes, 1,350 feet west and 300 feet south of the northeast corner of sec. 5, T. 29 S., R. 16 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium granular structure; hard, friable; slightly acid; abrupt smooth boundary.

A—6 to 11 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; hard, friable; slightly acid; clear smooth boundary.

BA—11 to 18 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, firm; neutral; clear smooth boundary.

Bt1—18 to 36 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 3/2) moist; moderate medium prismatic structure parting to moderate medium blocky; very hard, firm; continuous clay films on faces of peds; neutral; gradual smooth boundary.

Bt2—36 to 44 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, firm; clay films on some faces of peds; neutral; clear smooth boundary.

BC—44 to 51 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; weak coarse subangular blocky structure; hard, firm; mildly alkaline; clear smooth boundary.

C—51 to 60 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; massive; hard, friable; few films and threads of lime; moderately alkaline.

The thickness of the solum ranges from 30 to more than 60 inches. The depth to lime ranges from 36 to more than 60 inches.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. It is dominantly loam, but the range includes fine sandy loam. This horizon is slightly acid or neutral. The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is clay loam or sandy clay loam. It ranges from slightly acid to mildly alkaline. The C horizon has hue of 10YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 or 4. It is loam, clay loam, sandy clay loam, or fine sandy loam. It ranges from neutral to moderately alkaline.

Harney Series

The Harney series consists of deep, well drained, moderately slowly permeable soils on uplands. These soils formed in loess. Slope ranges from 0 to 3 percent.

Harney soils are similar to Holdrege soils and are commonly adjacent to Coly, Holdrege, and Uly soils. Coly soils are calcareous at a shallower depth than the Harney soils and contain less clay in the subsoil. They are on the steeper slopes below the Harney soils. Holdrege and Uly soils contain less clay in the subsoil than the Harney soils. Also, they are lower on the landscape.

Typical pedon of Harney silt loam, 0 to 1 percent slopes, 300 feet south and 125 feet west of the northeast corner of sec. 1, T. 29 S., R. 19 W.

Ap—0 to 5 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; many fine roots; slightly acid; abrupt smooth boundary.

AB—5 to 14 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; hard, friable; common fine roots; neutral; clear smooth boundary.

Bt—14 to 28 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium blocky structure; very hard, very firm; common fine roots; mildly alkaline; clear smooth boundary.

Bk—28 to 39 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; weak medium blocky structure; hard, firm; few fine roots; strong effervescence; common soft accumulations of lime and a few small concretions; moderately alkaline; gradual smooth boundary.

BCk—39 to 50 inches; yellowish brown (10YR 5/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; massive; hard, friable; strong effervescence; common soft accumulations of lime and a few small concretions; moderately alkaline; gradual smooth boundary.

C—50 to 60 inches; yellowish brown (10YR 5/4) silt loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 26 to 50 inches. The depth to lime ranges from 18 to 30 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is dominantly silt loam, but the range includes silty clay loam. This horizon is slightly acid or neutral. The Bt horizon has hue of 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3. It is silty clay loam or silty clay. It is neutral or mildly alkaline. The C horizon has hue of 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 4.

Hedville Series

The Hedville series consists of shallow, somewhat excessively drained, moderately permeable soils on uplands. These soils formed in material weathered from sandstone. Slope ranges from 4 to 30 percent.

Hedville soils are commonly adjacent to Lancaster, Owens, and Quinlan soils. Lancaster soils are 20 to 40 inches deep over sandstone. Owens soils are clayey. They are above the Hedville soils on the landscape. Quinlan soils are calcareous. They are lower on the landscape than the Hedville soils.

Typical pedon of Hedville fine sandy loam, in an area of Lancaster-Hedville complex, 4 to 20 percent slopes, 2,500 feet east and 300 feet north of the southwest corner of sec. 26, T. 30 S., R. 16 W.

A—0 to 11 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, very friable; many fine roots; slightly acid; abrupt wavy boundary.

R—11 inches; very pale brown (10YR 8/3) and reddish yellow (7.5YR 6/6) sandstone.

The thickness of the solum and the depth to bedrock range from 4 to 20 inches. The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is dominantly fine sandy loam, but the range includes loam. This horizon ranges from medium acid to neutral.

Holdrege Series

The Holdrege series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess. Slope ranges from 0 to 3 percent.

Holdrege soils are similar to Harney and Uly soils and are commonly adjacent to Coly, Harney, and Uly soils. Coly soils are calcareous at a shallower depth than the Holdrege soils and do not have a mollic epipedon. They are on the steeper slopes below the Holdrege soils. Harney soils have a subsoil that is more clayey than that of the Holdrege soils. Also, they are higher on the landscape. Uly soils do not have an argillic horizon. They are below the Holdrege soils on the landscape.

Typical pedon of Holdrege silt loam, 1 to 3 percent slopes, 2,090 feet south and 175 feet east of the northwest corner of sec. 30, T. 29 S., R. 18 W.

Ap—0 to 5 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

A—5 to 10 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable; neutral; clear smooth boundary.

BA—10 to 14 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; neutral; clear smooth boundary.

Bt—14 to 27 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; mildly alkaline; clear smooth boundary.

BCk—27 to 32 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; strong effervescence; common films and threads of lime; moderately alkaline; gradual smooth boundary.

C—32 to 60 inches; light yellowish brown (10YR 6/4) silt loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, friable; strong effervescence; common films, threads, and concretions of lime; moderately alkaline.

The thickness of the solum and the depth to lime range from 20 to 38 inches. The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2. It is typically silt loam, but the range includes loam and fine sandy loam. The B horizon has hue of 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is neutral or mildly alkaline. The C horizon has hue of 10YR, value of 6 or 7 (5 or 6 moist), and chroma of 2 to 4. It is mildly alkaline or moderately alkaline.

Krier Series

The Krier series consists of deep, somewhat poorly drained, rapidly permeable, saline-alkali soils on flood plains. These soils formed in alluvium. Slope is 0 to 1 percent.

Krier soils are commonly adjacent to Hedville, Lancaster, Quinlan, and Woodward soils. All the adjacent soils are less than 40 inches deep over bedrock. They are on uplands.

Typical pedon of Krier sandy loam, occasionally flooded, 500 feet east and 400 feet north of the southwest corner of sec. 33, T. 29 S., R. 16 W.

A—0 to 5 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; many fine and medium roots; slight effervescence; moderately alkaline; clear smooth boundary.

C1—5 to 11 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable; common fine roots; common fine salt crystals, visible when dry; slight effervescence; moderately alkaline; clear smooth boundary.

C2—11 to 18 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; few medium distinct brown (7.5YR 5/4) mottles; massive; soft, very friable; common fine roots; common fine salt crystals, visible when dry; slight effervescence; moderately alkaline; gradual smooth boundary.

2C3—18 to 60 inches; very pale brown (10YR 7/3) sand, pale brown (10YR 6/3) moist; common medium distinct strong brown (7.5YR 5/6) mottles; single grained; loose; few fine roots in the upper part; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 2 to 6 inches. The depth to lime ranges from 0 to 6 inches.

The A horizon has hue of 10YR, value of 4 or 5 (3 or 4 moist), and chroma of 1 or 2. It is dominantly sandy loam, but the range includes loam and clay loam. This horizon is mildly alkaline or moderately alkaline. The C horizon has hue of 10YR or 2.5Y, value of 4 to 7 (4 or 5 moist), and chroma of 1 or 2. It is sandy loam, loam, or clay loam to a depth of at least 10 inches. It is moderately alkaline or strongly alkaline and is slightly saline or moderately saline. The 2C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 3 or 4. It is fine sand, sand, or coarse sand. It ranges from mildly alkaline to strongly alkaline.

Lancaster Series

The Lancaster series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in material weathered from sandstone. Slope ranges from 4 to 12 percent.

Lancaster soils are commonly adjacent to Hedville, Owens, Quinlan, and Woodward soils. Hedville soils are 10 to 20 inches deep over bedrock. Owens soils are clayey. They are higher on the landscape than the Lancaster soils. Quinlan and Woodward soils are calcareous and are redder in the subsoil than the Lancaster soils. Also, they are lower on the landscape.

Typical pedon of Lancaster loam, in an area of Lancaster-Hedville complex, 4 to 20 percent slopes, 2,200 feet east and 300 feet north of the southwest corner of sec. 26, T. 30 S., R. 16 W.

A—0 to 13 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable; many fine roots; slightly acid; gradual smooth boundary.

Bt—13 to 23 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, friable; many fine roots; slightly acid; clear smooth boundary.

Cr—23 inches; very pale brown (10YR 7/3) and yellow (10YR 7/6) weathered sandstone.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is dominantly loam, but the range includes fine sandy loam. The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 to 6. It is loam, clay loam, or sandy clay loam. It is slightly acid or neutral.

Lincoln Series

The Lincoln series consists of deep, somewhat excessively drained, rapidly permeable soils on flood plains. These soils formed in sandy alluvium. Slope ranges from 0 to 2 percent.

Lincoln soils are commonly adjacent to Canadian, Dale, Plevna, and Waldeck soils. The well drained Canadian and Dale soils contain more clay in the subsoil than the Lincoln soils. They are on stream terraces. The poorly drained Plevna soils and the somewhat poorly drained Waldeck soils have a loamy subsoil. They are slightly lower on the flood plains than the Lincoln soils.

Typical pedon of Lincoln sandy loam, occasionally flooded, 1,900 feet south and 1,200 feet west of the northeast corner of sec. 15, T. 30 S., R. 17 W.

A—0 to 8 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; hard, friable; many fine roots; slight effervescence; moderately alkaline; clear smooth boundary.

AC—8 to 15 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) moist; single grained; loose; few fine roots; slight effervescence; moderately alkaline; gradual smooth boundary.

C—15 to 60 inches; very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; single grained; loose; few thin strata of fine sandy loam and loam; about 5 percent gravel below a depth of 50 inches; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 6 to 15 inches. The content of gravel is 0 to 10 percent throughout the profile.

The A horizon has hue of 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is dominantly sandy loam, but the range includes loamy sand, loam, and clay loam. This horizon is mildly alkaline or moderately alkaline. The C horizon has hue of 10YR, value of 6 to 8 (5 to 7 moist), and chroma of 2 to 6. It is loamy fine sand, loamy sand, fine sand, or sand.

Naron Series

The Naron series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loamy eolian deposits. Slope ranges from 0 to 3 percent.

Naron soils are similar to Attica, Farnum, and Shellabarger soils and are commonly adjacent to Attica, Carwile, Farnum, and Pratt soils. Attica soils contain less clay in the subsoil than the Naron soils. Also, they are higher on the landscape. The somewhat poorly drained Carwile soils have a clayey subsoil and are in depressions. Farnum soils contain more clay in the subsoil than the Naron soils. Also, they are lower on the landscape. Pratt soils have a sandy subsoil and are generally on the steeper slopes. Shellabarger soils are redder in the subsoil than the Naron soils.

Typical pedon of Naron fine sandy loam, 1 to 3 percent slopes, 2,565 feet west and 65 feet south of the northeast corner of sec. 18, T. 28 S., R. 17 W.

Ap—0 to 6 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable; many fine roots; slightly acid; abrupt smooth boundary.

A—6 to 10 inches; brown (10YR 5/3) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, very friable; many fine roots; slightly acid; clear smooth boundary.

BA—10 to 15 inches; brown (10YR 4/3) sandy clay loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable; many fine roots; slightly acid; clear smooth boundary.

Bt—15 to 36 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to weak medium subangular blocky; hard, friable; common fine roots; slightly acid; gradual smooth boundary.

BC—36 to 48 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; weak very coarse prismatic structure; hard, friable; few fine roots; neutral; gradual smooth boundary.

C—48 to 60 inches; yellowish brown (10YR 5/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; massive; hard, friable; mildly alkaline.

The thickness of the solum ranges from 36 to 60 inches. The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. It is typically fine sandy loam, but in some pedons it is loamy fine sand. It is slightly acid or neutral. The B horizon has hue of 10YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is sandy clay loam or fine sandy loam. The C horizon has hue of 10YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 or 4. It is fine sandy loam or loamy fine sand. It is neutral or mildly alkaline.

Ness Series

The Ness series consists of deep, poorly drained, very slowly permeable soils in shallow upland depressions that are subject to ponding. These soils formed in clayey alluvium and eolian sediments. Slope is 0 to 1 percent.

Ness soils are commonly adjacent to Harney and Holdrege soils. The adjacent soils are well drained and contain less clay in the subsoil than the Ness soils. Also, they are higher on the landscape.

Typical pedon of Ness silty clay, 600 feet north and 300 feet west of the southeast corner of sec. 19, T. 29 S., R. 20 W.

A1—0 to 11 inches; gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; moderate very fine blocky structure; very hard, very firm; many fine and medium roots; neutral; gradual smooth boundary.

A2—11 to 33 inches; gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; moderate fine blocky structure; very hard, very firm; common slickensides; common fine and medium roots; neutral; gradual smooth boundary.

AC—33 to 38 inches; light brownish gray (10YR 6/2) silty clay, grayish brown (10YR 5/2) moist; weak fine blocky structure; very hard, very firm; few fine faint brown (10YR 5/3) mottles; neutral; gradual smooth boundary.

C—38 to 60 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; massive; hard, firm; common threads and seams of lime; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 50 inches. The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1. It is neutral or mildly alkaline. The C horizon has hue of 10YR, value of 5 to 7 (4 or 5 moist), and chroma of 2 or 3. It is mildly alkaline or moderately alkaline.

New Cambria Series

The New Cambria series consists of deep, moderately well drained, slowly permeable soils on stream terraces. These soils formed in calcareous, clayey alluvium. Slope ranges from 0 to 2 percent.

New Cambria soils are commonly adjacent to Owens, Plevna, and Tobin soils. Owens soils are shallow over shale and are on uplands. The poorly drained Plevna and well drained Tobin soils are on flood plains. Plevna soils have a loamy subsoil, and Tobin soils have a silty subsoil.

Typical pedon of New Cambria silty clay, 1,100 feet south and 1,980 feet east of the northwest corner of sec. 23, T. 29 S., R. 17 W.

A1—0 to 5 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; very hard, very firm; many fine roots; neutral; clear smooth boundary.

A2—5 to 12 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; very hard, very firm; many fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

Bw—12 to 36 inches; brown (10YR 5/3) silty clay, dark brown (10YR 3/3) moist; moderate medium blocky structure; very hard, very firm; common fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C—36 to 60 inches; pale brown (10YR 6/3) silty clay, brown (10YR 4/3) moist; massive; very hard, firm; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 25 to 45 inches. The depth to lime ranges from 0 to 10 inches.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly silty clay, but the range includes silty clay loam. This horizon ranges from neutral to moderately alkaline. The B horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 to 3. It is silty clay, clay, or silty clay loam. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6 (4 or 5 moist), and chroma of 1 to 3. It is silty clay or silty clay loam.

Owens Series

The Owens series consists of shallow, well drained, very slowly permeable soils on uplands. These soils formed in material weathered from shale. Slope ranges from 6 to 25 percent.

Owens soils are commonly adjacent to Canlon, Case, Lancaster, and New Cambria soils. Canlon and Case soils are higher on the landscape than the Owens soils. Canlon soils have a loamy subsoil. Case and New Cambria soils are more than 40 inches deep over bedrock. New Cambria soils are on stream terraces. Lancaster soils are 20 to 40 inches deep over sandstone. They are lower on the landscape than the Owens soils.

Typical pedon of Owens clay, 6 to 25 percent slopes, 550 feet west and 475 feet north of the southeast corner of sec. 22, T. 29 S., R. 17 W.

A—0 to 6 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; weak medium granular structure; hard, firm; many fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

Bw—6 to 15 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate medium blocky structure; very hard, very firm; common fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

Cr—15 inches; gray (10YR 5/1) clayey shale.

The thickness of the solum and the depth to shale range from 10 to 20 inches. Ironstone, limestone, or sandstone fragments cover 0 to 15 percent of the surface.

The A horizon has hue of 2.5Y or 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is dominantly clay, but the range includes clay loam and silty clay. The Bw horizon has hue of 2.5Y or 10YR, value of 4 to 6 (4 or 5 moist), and chroma of 2 to 6. It is clay, clay loam, or silty clay.

Plevna Series

The Plevna series consists of deep, poorly drained, moderately rapidly permeable soils on flood plains. These soils formed in alluvium. Slope ranges from 0 to 2 percent.

Plevna soils are commonly adjacent to Canadian, Dale, Lincoln, and Waldeck soils. The well drained Canadian and Dale soils are on stream terraces. The somewhat excessively drained Lincoln soils are sandy. They are on flood plains upstream from the Plevna soils. The somewhat poorly drained Waldeck soils are occasionally flooded. They are on flood plains downstream from the Plevna soils.

Typical pedon of Plevna loam, frequently flooded, 1,660 feet south and 300 feet east of the northwest corner of sec. 10, T. 29 S., R. 17 W.

A1—0 to 5 inches; grayish brown (10YR 5/2) loam, very dark gray (10YR 3/1) moist; weak medium granular structure; hard, friable; many fine and medium roots; strong effervescence; moderately alkaline; clear smooth boundary.

A2—5 to 9 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; common fine prominent yellowish red (5YR 5/6) mottles; weak medium granular structure; hard, friable; many fine and medium roots; weak effervescence; moderately alkaline; clear smooth boundary.

A3—9 to 15 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; common medium prominent yellowish red (5YR 5/6) mottles; weak medium granular structure; slightly hard, very friable; common fine roots; moderately alkaline; clear smooth boundary.

Bg1—15 to 30 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; common medium prominent yellowish red (5YR 5/6) mottles; weak coarse granular structure; slightly hard, very friable; common fine roots; neutral; gradual smooth boundary.

Bg2—30 to 48 inches; light brownish gray (2.5Y 6/2) fine sandy loam, dark gray (10YR 4/1) moist; few fine prominent yellowish brown (10YR 5/6) mottles; massive; hard, very friable; few roots; strong effervescence; moderately alkaline; gradual smooth boundary.

2C—48 to 60 inches; pale brown (10YR 6/3) sand, brown (10YR 5/3) moist; single grained; loose; moderately alkaline.

The thickness of the solum ranges from 30 to 54 inches. The soils range from neutral to moderately alkaline throughout.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly loam, but the range includes fine sandy loam and sandy loam. The Bg horizon has hue of 10YR or 2.5Y, value of 5 or 6 (4 or 5 moist), and chroma of 1 or 2. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 1 to 4.

Pratt Series

The Pratt series consists of deep, well drained, rapidly permeable soils on uplands. These soils formed in sandy eolian deposits. Slope ranges from 1 to 15 percent.

Pratt soils are similar to Attica and Tivoli soils and are commonly adjacent to Attica, Carwile, Naron, and Tivoli soils. Attica soils have a loamy subsoil. They are lower on the landscape than the Pratt soils. The somewhat poorly drained Carwile soils have a clayey subsoil and are in depressions. Naron soils have a loamy subsoil. They are lower on the landscape than the Pratt soils. The excessively drained Tivoli soils do not have an argillic horizon. They are on ridges above the Pratt soils.

Typical pedon of Pratt loamy fine sand, undulating, 300 feet west and 100 feet south of the northeast corner of sec. 26, T. 27 S., R. 19 W.

Ap—0 to 6 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable; slightly acid; abrupt smooth boundary.

A—6 to 12 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) moist; weak medium granular structure; soft, very friable; slightly acid; clear smooth boundary.

Bt—12 to 36 inches; light yellowish brown (10YR 6/4) loamy fine sand, dark yellowish brown (10YR 4/4) moist; weak medium prismatic structure parting to weak medium granular; slightly hard, very friable; slightly acid; gradual smooth boundary.

C—36 to 60 inches; light yellowish brown (10YR 6/4) loamy fine sand, yellowish brown (10YR 5/4) moist; single grained; loose; neutral.

The solum ranges from 24 to 50 inches in thickness. The soils are slightly acid or neutral throughout.

The A horizon has hue of 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3. It is dominantly loamy fine sand, but the range includes fine sand. The Bt horizon has hue of 10YR, value of 4 to 6 (4 or 5 moist), and chroma of 2 to 4. The C horizon has hue of 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 to 6. It is loamy fine sand or fine sand.

Quinlan Series

The Quinlan series consists of shallow, well drained, moderately permeable soils on uplands. These soils formed in material weathered from sandstone. Slope ranges from 6 to 25 percent.

Quinlan soils are similar to Woodward soils and are commonly adjacent to Hedville, Lancaster, and Woodward soils. Hedville and Lancaster soils are noncalcareous. They are higher on the landscape than the Quinlan soils. Woodward soils are 20 to 40 inches deep over bedrock.

Typical pedon of Quinlan loam, in an area of Quinlan-Woodward loams, 6 to 25 percent slopes, 2,425 feet east and 1,500 feet south of the northwest corner of sec. 23, T. 30 S., R. 16 W.

A—0 to 7 inches; reddish brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; weak medium granular structure; hard, friable; many fine and medium roots; strong effervescence; moderately alkaline; gradual smooth boundary.

Bw—7 to 15 inches; reddish brown (5YR 5/4) loam, dark reddish brown (2.5YR 3/4) moist; weak medium granular structure; slightly hard, friable; many fine roots; violent effervescence; moderately alkaline; gradual smooth boundary.

Cr—15 inches; reddish brown (2.5YR 5/4), platy, fine grained sandstone, dark reddish brown (2.5YR 3/4) moist; few fine roots and concentrations of soft, powdery lime between plates in the upper 6 inches; violent effervescence.

The thickness of the solum and the depth to bedrock range from 10 to 20 inches. The soils are mildly alkaline or moderately alkaline throughout. The A horizon has hue of 5YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 or 4. The Bw horizon has hue of 2.5YR or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 4 to 6.

Shellabarger Series

The Shellabarger series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in old alluvium. Slope ranges from 2 to 15 percent.

Shellabarger soils are similar to Naron soils and are commonly adjacent to Albion and Farnum soils. Albion soils contain less clay in the subsoil than the Shellabarger soils. Also, they are lower on the landscape. Farnum soils contain more clay in the subsoil than the Shellabarger soils. Also, they are higher on the landscape. Naron soils are not so red in the subsoil as the Shellabarger soils.

Typical pedon of Shellabarger loam, 2 to 6 percent slopes, 1,500 feet east and 1,200 feet south of the northwest corner of sec. 13, T. 29 S., R. 16 W.

A—0 to 11 inches; reddish brown (5YR 5/3) loam, dark reddish brown (5YR 3/3) moist; weak fine granular structure; slightly hard, friable; many fine roots; slightly acid; clear smooth boundary.

BA—11 to 16 inches; reddish brown (5YR 5/3) sandy clay loam, dark reddish brown (5YR 3/3) moist; weak fine subangular blocky structure; slightly hard, friable; many fine roots; slightly acid; clear smooth boundary.

Bt—16 to 32 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/3) moist; moderate medium subangular blocky structure; hard, friable; common fine roots; slightly acid; gradual smooth boundary.

BC—32 to 44 inches; brown (7.5YR 5/4) sandy loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, very friable; few fine roots; neutral; gradual smooth boundary.

C—44 to 60 inches; light brown (7.5YR 6/4) sandy loam, brown (7.5YR 5/4) moist; massive; soft, very friable; neutral.

The thickness of the solum ranges from 30 to 60 inches. The A horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is loam or sandy loam. It is slightly acid or medium acid. The Bt horizon has hue of 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 to 6. It is sandy clay loam or sandy loam. It is slightly acid or neutral. The C horizon has hue of 7.5YR or 5YR, value of 4 to 6 (4 or 5 moist), and chroma of 4 to 6. It is coarse sandy loam or sandy loam. Some pedons have loamy sand or sand below a depth of 40 inches.

Tivoli Series

The Tivoli series consists of deep, excessively drained, rapidly permeable soils on uplands. These soils formed in sandy eolian deposits. Slope ranges from 5 to 30 percent.

Tivoli soils are similar to Pratt soils and are commonly adjacent to those soils. Pratt soils have an argillic horizon. They are on the lower side slopes.

Typical pedon of Tivoli fine sand, hilly, 125 feet south and 75 feet west of the center of sec. 16, T. 27 S., R. 20 W.

A—0 to 6 inches; brown (10YR 5/3) fine sand, dark brown (10YR 4/3) moist; single grained; loose; many fine roots; neutral; gradual smooth boundary.

C—6 to 60 inches; light yellowish brown (10YR 6/4) fine sand, yellowish brown (10YR 5/4) moist; single grained; loose; roots decrease in abundance with increasing depth; neutral.

The soils range from slightly acid to mildly alkaline throughout. The A horizon has hue of 10YR, value of 4 to 6 (4 or 5 moist), and chroma of 2 to 4. It is fine sand or loamy fine sand. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 3 to 6.

Tobin Series

The Tobin series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in silty, calcareous alluvium. Slope ranges from 0 to 2 percent.

Tobin soils are similar to Dale soils and are commonly adjacent to Coly, Dale, New Cambria, and Uly soils. Coly soils do not have a mollic epipedon and are on uplands. Dale soils are subject to rare flooding and are on stream terraces. The moderately well drained New Cambria soils are more clayey than the Tobin soils. They are on stream terraces. Uly soils have a mollic epipedon that is thinner than that of the Tobin soils. They are on uplands.

Typical pedon of Tobin silt loam, occasionally flooded, 275 feet east and 100 feet south of the northwest corner of sec. 12, T. 30 S., R. 19 W.

Ap—0 to 8 inches; brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

A—8 to 25 inches; dark grayish brown (10YR 4/2) silt loam, very dark gray (10YR 3/1) moist; moderate medium granular structure; slightly hard, friable; neutral; clear smooth boundary.

AC—25 to 33 inches; dark grayish brown (10YR 4/2) silt loam, very dark gray (10YR 3/1) moist; weak medium granular structure; slightly hard, friable; strong effervescence; common films and threads of lime; moderately alkaline; diffuse smooth boundary.

C—33 to 60 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable; strong effervescence; few films and threads of lime; moderately alkaline.

The thickness of the solum ranges from 20 to 50 inches. The depth to lime ranges from 15 to 40 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 to 3. It is dominantly silt loam, but the range includes silty clay loam. This horizon is slightly acid or neutral. The C horizon has hue of 10YR, value of 5 to 7 (4 or 5 moist), and chroma of 1 to 3. It is mildly alkaline or moderately alkaline.

Uly Series

The Uly series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in silty, calcareous loess. Slope ranges from 3 to 7 percent.

Uly soils are similar to Coly and Holdrege soils and are commonly adjacent to Coly, Harney, and Holdrege soils. Coly soils do not have a mollic epipedon. They are calcareous at a shallower depth than the Uly soils. They are on the steeper slopes below the Uly soils. Harney and Holdrege soils have an argillic horizon. They are on broad ridgetops.

Typical pedon of Uly silt loam, 3 to 7 percent slopes, 900 feet east and 150 feet south of the northwest corner of sec. 12, T. 30 S., R. 19 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

A—6 to 10 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium granular structure; slightly hard, friable; neutral; clear smooth boundary.

Bw—10 to 16 inches; brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak very fine subangular blocky; hard, friable; neutral; clear smooth boundary.

BC—16 to 22 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, friable; few worm casts; few fine spots of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C—22 to 60 inches; light yellowish brown (10YR 6/4) silt loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable; common.fine spots and threads of lime; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 12 to 36 inches. The depth to lime ranges from 8 to 25 inches.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2. It is slightly acid or neutral. The Bw horizon has hue of 10YR, value of 4 to 6 (2 to 5 moist), and chroma of 2 or 3. It ranges from neutral to moderately alkaline. The C horizon has hue of 10YR or 7.5YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is mildly alkaline or moderately alkaline.

Waldeck Series

The Waldeck series consists of deep, somewhat poorly drained, moderately rapidly permeable soils on flood plains. These soils formed in alluvium. Slope ranges from 0 to 2 percent.

Waldeck soils are commonly adjacent to Canadian, Dale, Lincoln, and Plevna soils. Canadian and Dale soils are well drained and are on stream terraces. The somewhat excessively drained Lincoln soils are sandy. They are on the slightly higher flood plains. Plevna soils are poorly drained. They are on flood plains upstream from the Waldeck soils.

Typical pedon of Waldeck loam, occasionally flooded, 200 feet north and 125 feet west of the center of sec. 13, T. 30 S., R. 17 W.

A—0 to 14 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; hard, friable; many fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

AC—14 to 26 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; weak medium granular structure; slightly hard, very friable; common fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—26 to 41 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; common medium distinct reddish yellow (7.5YR 6/6) and grayish brown (10YR 5/2) mottles; massive; slightly hard, very friable; thin strata and bedding planes; strong effervescence; moderately alkaline; gradual smooth boundary.

2C2—41 to 60 inches; very pale brown (10YR 7/3) fine sand, brown (10YR 5/3) moist; single grained; loose; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 18 to 30 inches. The depth to lime ranges from 0 to 12 inches. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly loam, but the range includes fine sandy loam. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4.

Woodward Series

The Woodward series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in material weathered from sandstone. Slope ranges from 6 to 20 percent.

Woodward soils are similar to Quinlan soils and are commonly adjacent to Hedville, Lancaster, and Quinlan soils. Hedville and Lancaster soils are noncalcareous and are browner than the Woodward soils. Also, they are higher on the landscape. Quinlan soils are 10 to 20 inches deep over sandstone.

Typical pedon of Woodward loam, in an area of Quinlan-Woodward loams, 6 to 25 percent slopes, 2,625 feet east and 1,550 feet south of the northwest corner of sec. 23, T. 30 S., R. 16 W.

A—0 to 8 inches; reddish brown (5YR 5/3) loam, dark reddish brown (5YR 3/3) moist; weak medium granular structure; hard, friable; many fine and medium roots; few worm casts; slight effervescence; mildly alkaline; gradual smooth boundary.

Bw—8 to 19 inches; reddish brown (5YR 5/4) loam, dark reddish brown (5YR 3/4) moist; moderate medium granular structure; slightly hard, friable; many fine and medium roots; few worm casts; strong effervescence; moderately alkaline; gradual smooth boundary.

BC—19 to 27 inches; reddish brown (2.5YR 5/4) loam, dark reddish brown (2.5YR 3/4) moist; weak medium granular structure; slightly hard, friable; many fine roots; few worm casts; few films of soft, powdery lime; violent effervescence; moderately alkaline; gradual smooth boundary.

Cr—27 inches; reddish brown (2.5YR 5/4), platy, fine grained sandstone, reddish brown (2.5YR 4/4) moist; few fine roots and concentrations of soft, powdery lime between plates in the upper 6 inches; strong effervescence.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. The depth to lime ranges from 0 to 10 inches. The A horizon has hue of 5YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 or 4. The Bw horizon has hue of 2.5YR or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 4 to 6.

Formation of the Soils

Soil forms through processes that act on deposited or accumulated geologic material. As a result of these processes, it is constantly changing. The characteristics of the soil at any given point are determined by the interaction among five factors of soil formation—the physical and mineral composition of the parent material, the climate, the plant and animal life on and in the soil, the relief, and the length of time that the forces of soil formation have acted on the soil material. Each of these factors affects the formation of every soil, and each modifies the effects of the other four. The effects of the individual factors vary from place to place.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a soil that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil. Generally, a long time is needed for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four.

Plant and Animal Life

Prairie grasses generally provide the organic matter that has accumulated in the soils of Kiowa County. This organic matter darkened the surface layer and the upper part of the subsoil. The largest amount of organic matter is generally near the surface. Farnum soils, for example, are dark grayish brown in the upper 18 inches, where the content of organic matter is highest. Because the content is lower with increasing depth, the subsoil is brown and the substratum is pale brown.

When plants decay, micro-organisms, such as bacteria, nematodes, and protozoa, act upon the organic matter and decompose it into stable humus. Nitrogen-fixing bacteria in nodules on the roots of certain legumes remove nitrogen from the air. When the bacteria die, the nitrogen becomes available in the soil. Earthworms, insects, and small burrowing animals affect the formation of soils by mixing and working the organic matter and mineral material. The mixing and working accelerate soil formation and make the soil more friable.

Human activities also have an effect on soils. Cultivation in some areas has increased the extent of erosion, thereby reducing the content of organic matter. Many areas of Case and Coly soils that support native grasses have a darker surface layer than is evident in areas that have been cultivated.

Climate

Climate directly affects soil formation by weathering the parent material. It indirectly affects soil formation through its effect on the plants and animals on or in the soil.

The continental climate of Kiowa County is characterized by intermittent dry and moist periods. These periods can last for less than a year or for several years. The soil material dries to varying depths during dry periods. It slowly regains moisture during wet periods and can become so saturated that excess moisture penetrates the substratum. The accumulation of soft lime in the substratum of Harney soils is an indication of this excess moisture. Because of the downward movement of water, some of the basic nutrients, and even clay particles, have been leached from the upper horizons of some soils.

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Relief

Relief, or lay of the land, influences the formation of the soils through its effect on drainage, erosion, temperature, and plant cover. Because of its effect on soil moisture and soil temperature, relief also affects the kinds of plants and animals that live on and in the soil. Runoff is excessive in moderately sloping to steep areas because the soil is unable to absorb all the moisture from rainfall. Coly soils, for example, have a thin surface layer because runoff and erosion are excessive and because the limited amount of moisture does not produce the large amount of vegetation needed for a buildup of organic matter.

Soils in low lying areas, where surface drainage is poor, are likely to have a grayish or mottled subsoil. Carwile and Ness soils are examples. Some of the soils along the streams are somewhat poorly drained or poorly drained. Plevna and Waldeck soils and examples.

Nearly level soils on bottom land, such as Dale and New Cambria soils, receive runoff from the higher lying areas. The upper layers of these soils tend to be thicker because the runoff deposits additional soil material.

Time

Time is needed for the formation of soils from parent material. Some soils form rapidly, and others form slowly. The length of time required for the formation of a particular soil depends on the other factors of soil formation. As water moves downward through the soil, soluble material and fine particles are leached from the surface layer and are deposited in the subsoil. The length of time required for this process depends chiefly on how long the soil material has been in place and how much water penetrates the surface.

The soils in Kiowa County range from immature to mature. Soils on low bottoms, such as Tobin soils, are subject to stream overflow. They received new sediment with each flood. As a result, they are immature. They have a thick, dark surface soil, but the soil structure is generally weak.

Mature soils have distinct horizons. Harney soils are an example. The upper part of these soils is leached of carbonates, and the fine clay has accumulated in the subsoil.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Forb. Any herbaceous plant not a grass or a sedge.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:
O horizon.—An organic layer of fresh and decaying plant residue.
A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.
E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.
B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.
C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.
Cr horizon.—Soft, consolidated bedrock beneath the soil.
R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6 1 to 6.5
Neutral	6 6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Wind stripcropping. Growing crops in relatively narrow strips that are perpendicular to the direction of the prevailing winds.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-76 at Greensburg, Kansas]

Month	Temperature					Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	In	In	In		In
January----	44.3	19.3	31.8	71	-7	0.52	0.06	0.75	1	3.9
February---	49.0	23.4	36.2	81	-2	.92	.19	.93	2	4.4
March------	56.4	29.3	42.9	88	4	1.20	.17	2.15	3	3.8
April------	69.4	41.7	55.6	93	19	2.23	.87	2.91	3	.5
May--------	78.4	51.9	65.2	100	33	3.13	1.28	4.72	6	.0
June-------	88.1	61.9	75.0	106	45	3.66	1.37	5.88	6	.0
July-------	93.6	66.7	80.2	107	53	2.66	.96	4.28	5	.0
August-----	92.8	65.2	79.0	107	51	2.72	.98	4.15	5	.0
September--	84.0	56.0	70.0	102	36	2.02	.61	4.29	4	.0
October----	72.9	45.0	59.0	95	23	1.90	.47	2.77	3	.5
November---	57.1	31.0	44.1	78	4	.84	.03	1.99	2	1.7
December---	46.3	22.1	34.2	72	-3	.75	.04	.97	2	3.6
Year-----	69.4	42.8	56.1	109	-10	22.55	15.81	28.91	42	18.4

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Minimum temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 11	April 23	May 8
2 years in 10 later than--	April 6	April 18	May 3
5 years in 10 later than--	March 28	April 8	April 23
First freezing temperature in fall:			
1 year in 10 earlier than--	October 25	October 18	October 8
2 years in 10 earlier than--	October 29	October 23	October 12
5 years in 10 earlier than--	November 8	November 1	October 22

TABLE 3.--GROWING SEASON

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	207	188	162
8 years in 10	213	194	169
5 years in 10	225	207	182
2 years in 10	237	219	195
1 year in 10	243	225	202

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
An	Albion sandy loam, 1 to 4 percent slopes	1,600	0.3
As	Albion-Shellabarger sandy loams, 4 to 15 percent slopes	11,350	2.5
At	Attica loamy fine sand, 1 to 4 percent slopes	21,050	4.6
Ax	Attica-Carwile complex, 0 to 4 percent slopes	4,600	1.0
Ca	Canadian fine sandy loam	1,200	0.3
Cc	Carwile fine sandy loam	3,550	0.8
Ce	Case clay loam, 2 to 7 percent slopes	7,550	1.6
Cf	Case clay loam, 7 to 15 percent slopes	21,050	4.6
Cg	Case-Canlon complex, 7 to 20 percent slopes	4,500	1.0
Ck	Clark loam, 1 to 3 percent slopes	5,900	1.3
Cm	Clark loam, 3 to 7 percent slopes	6,450	1.4
Co	Coly silt loam, 4 to 9 percent slopes	22,300	4.8
Cp	Coly silt loam, 20 to 40 percent slopes	2,850	0.6
Ct	Coly-Tobin silt loams, 0 to 20 percent slopes	13,400	2.9
Da	Dale silt loam	5,800	1.3
Fa	Farnum loam, 0 to 1 percent slopes	8,600	1.9
Fb	Farnum loam, 1 to 3 percent slopes	13,150	2.8
Ha	Harney silt loam, 0 to 1 percent slopes	33,300	7.2
Hb	Harney silt loam, 1 to 3 percent slopes	43,100	9.2
He	Hedville-Rock outcrop complex, 15 to 30 percent slopes	620	0.1
Ho	Holdrege silt loam, 0 to 1 percent slopes	4,200	0.9
Hp	Holdrege silt loam, 1 to 3 percent slopes	21,750	4.7
Kr	Krier sandy loam, occasionally flooded	153	*
Lh	Lancaster-Hedville complex, 4 to 20 percent slopes	5,800	1.3
Ln	Lincoln sandy loam, occasionally flooded	4,350	0.9
Na	Naron fine sandy loam, 0 to 1 percent slopes	5,100	1.1
Nb	Naron fine sandy loam, 1 to 3 percent slopes	14,350	3.1
Ne	Ness silty clay	800	0.2
Nw	New Cambria silty clay	1,250	0.3
Oe	Owens clay, 6 to 25 percent slopes	18,500	4.0
Pe	Plevna loam, frequently flooded	1,800	0.4
Pr	Pratt loamy fine sand, undulating	52,000	11.0
Ps	Pratt loamy fine sand, rolling	25,000	5.4
Pt	Pratt-Tivoli loamy fine sands, rolling	37,800	8.2
Qw	Quinlan-Woodward loams, 6 to 25 percent slopes	4,200	0.9
Sh	Shellabarger loam, 2 to 6 percent slopes	3,350	0.7
Th	Tivoli fine sand, hilly	10,900	2.4
To	Tobin silt loam, channeled	3,050	0.7
Ts	Tobin silt loam, occasionally flooded	3,500	0.8
Uc	Uly silt loam, 3 to 7 percent slopes	9,650	2.1
Wa	Waldeck loam, occasionally flooded	3,150	0.7
	Total	462,573	100.0

* Less than 0.1 percent.

TABLE 5.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS

[Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Land capability		Wheat		Grain sorghum		Corn		Soybeans		Alfalfa hay	
	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Bu	Bu	Bu	Bu	Bu	Bu	Tons	Tons
An---------------- Albion	IIIe	IIIe	22	---	35	---	---	---	---	---	---	---
As---------------- Albion-Shellabarger	VIe	---	---	---	---	---	---	---	---	---	---	---
At---------------- Attica	IIIe	IIIe	32	45	47	105	---	130	---	35	---	6.5
Ax---------------- Attica-Carwile	IIIe	IIIe	28	40	42	105	---	130	---	35	---	6.5
Ca---------------- Canadian	IIe	IIe	33	---	49	---	---	---	---	---	---	---
Cc---------------- Carwile	IIw	IIw	26	40	40	105	---	130	---	35	---	6.5
Ce---------------- Case	IVe	---	20	---	35	---	---	---	---	---	---	---
Cf---------------- Case	VIe	---	---	---	---	---	---	---	---	---	---	---
Cg---------------- Case-Canlon	VIe	---	---	---	---	---	---	---	---	---	---	---
Ck---------------- Clark	IIIe	IIIe	27	---	40	---	---	---	---	---	---	---
Cm---------------- Clark	IVe	---	25	---	38	---	---	---	---	---	---	---
Co---------------- Coly	IVe	IVe	22	---	30	---	---	---	---	---	---	---
Cp---------------- Coly	VIIe	---	---	---	---	---	---	---	---	---	---	---
Ct---------------- Coly-Tobin	VIe	---	---	---	---	---	---	---	---	---	---	---
Da---------------- Dale	IIc	I	36	---	50	---	---	---	---	---	---	---
Fa---------------- Farnum	IIc	I	35	55	50	120	---	---	---	---	---	---
Fb---------------- Farnum	IIe	IIe	33	50	48	110	---	---	---	---	---	---
Ha---------------- Harney	IIc	I	34	50	46	120	---	---	---	---	---	---
Hb---------------- Harney	IIe	IIe	31	45	42	110	---	---	---	---	---	---
He---------------- Hedville-Rock outcrop	VIIs	---	---	---	---	---	---	---	---	---	---	---
Ho---------------- Holdrege	IIc	I	35	55	48	125	---	---	---	---	---	---

TABLE 5.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability		Wheat		Grain sorghum		Corn		Soybeans		Alfalfa hay	
	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Bu	Bu	Bu	Bu	Bu	Bu	Tons	Tons
Hp----------------- Holdrege	IIe	IIe	33	50	46	120	---	140	---	---	---	---
Kr----------------- Krier	VIs	---	---	---	---	---	---	---	---	---	---	---
Lh----------------- Lancaster- Hedville	VIe	---	---	---	---	---	---	---	---	---	---	---
Ln----------------- Lincoln	VIw	---	---	---	---	---	---	---	---	---	---	---
Na----------------- Naron	IIe	I	34	50	49	120	---	135	---	40	---	7.0
Nb----------------- Naron	IIe	IIe	31	45	47	110	---	125	---	35	---	6.5
Ne----------------- Ness	VIw	---	---	---	---	---	---	---	---	---	---	---
Nw----------------- New Cambria	IIs	IIs	31	---	45	---	---	---	---	---	---	---
Oe----------------- Owens	VIe	---	---	---	---	---	---	---	---	---	---	---
Pe----------------- Plevna	Vw	---	---	---	---	---	---	---	---	---	---	---
Pr----------------- Pratt	IIIe	IIIe	27	40	41	90	---	115	---	35	---	5.5
Ps----------------- Pratt	IVe	IVe	25	35	40	85	---	105	---	30	---	5.5
Pt----------------- Pratt-Tivoli	VIe	IVe	---	30	---	80	---	100	---	---	---	5.0
Qw----------------- Quinlan-Woodward	VIe	---	---	---	---	---	---	---	---	---	---	---
Sh----------------- Shellabarger	IIIe	IIIe	28	---	44	---	---	---	---	---	---	---
Th----------------- Tivoli	VIIe	---	---	---	---	---	---	---	---	---	---	---
To----------------- Tobin	Vw	---	---	---	---	---	---	---	---	---	---	---
Ts----------------- Tobin	IIw	IIw	35	---	45	---	---	---	---	---	---	---
Uc----------------- Uly	IIIe	IIIe	29	---	37	---	---	---	---	---	---	---
Wa----------------- Waldeck	IIIw	IIIw	27	---	45	---	---	---	---	---	---	---

TABLE 6.--RANGELAND PRODUCTIVITY

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
An: Albion	Sandy	4,000	3,000	2,000
As*:				
Albion	Sandy	4,000	3,000	2,000
Shellabarger	Sandy	4,500	3,200	2,000
At: Attica	Sandy	4,500	3,000	2,000
Ax*:				
Attica	Sandy	4,500	3,000	2,000
Carwile	Sandy	5,000	3,800	3,000
Ca: Canadian	Sandy Terrace	6,000	4,500	3,000
Cc: Carwile	Sandy	5,000	3,800	3,000
Ce, Cf: Case	Limy Upland	3,500	2,500	1,500
Cg*:				
Case	Limy Upland	3,500	2,500	1,500
Canlon	Shallow Limy	2,400	1,600	900
Ck, Cm: Clark	Limy Upland	3,500	2,500	1,500
Co: Coly	Limy Upland	3,500	2,500	1,500
Cp: Coly	Loess Breaks	3,000	2,000	1,400
Ct*:				
Coly	Limy Upland	3,500	2,500	1,500
Tobin	Loamy Lowland	6,000	5,000	4,000
Da: Dale	Loamy Terrace	5,000	4,000	3,000
Fa, Fb: Farnum	Loamy Upland	4,000	3,000	2,000
Ha, Hb: Harney	Loamy Upland	3,500	2,500	1,500
He*:				
Hedville	Shallow Sandstone	3,000	2,000	1,000
Rock outcrop.				
Ho, Hp: Holdrege	Loamy Upland	4,000	3,000	2,000
Kr: Krier	Saline Subirrigated	6,500	5,500	4,000

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
Lh*:				
Lancaster	Loamy Upland	4,000	3,000	2,000
Hedville	Shallow Sandstone	3,000	2,000	1,000
Ln Lincoln	Sandy Lowland	3,000	2,280	1,800
Na, Nb Naron	Sandy	4,500	3,000	2,000
Ne Ness	---	2,000	1,500	500
Nw New Cambria	Clay Terrace	5,000	4,000	2,500
Oe Owens	Blue Shale	3,000	2,000	1,500
Pe Plevna	Subirrigated	9,000	8,000	7,000
Pr, Ps Pratt	Sands	4,500	3,500	2,500
Pt*:				
Pratt	Sands	4,500	3,500	2,500
Tivoli	Sands	4,000	3,000	2,000
Qw*:				
Quinlan	Shallow Prairie	2,500	1,800	1,300
Woodward	Loamy Upland	4,000	2,800	2,000
Sh Shellabarger	Sandy	4,500	3,200	2,000
Th Tivoli	Choppy Sands	2,000	1,400	1,000
To, Ts Tobin	Loamy Lowland	6,000	5,000	4,000
Uc Uly	Loamy Upland	4,000	3,200	2,000
Wa Waldeck	Subirrigated	9,000	8,000	7,000

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
An----------------- Albion	Lilac, fragrant sumac, Siberian peashrub.	Russian-olive, Rocky Mountain juniper, Russian mulberry.	Eastern redcedar, bur oak, Austrian pine, honeylocust, green ash.	Siberian elm------	---
As*:					
Albion-----------	Lilac, fragrant sumac, Siberian peashrub.	Russian-olive, Rocky Mountain juniper, Russian mulberry.	Eastern redcedar, bur oak, Austrian pine, honeylocust, green ash.	Siberian elm------	---
Shellabarger-----	Lilac, American plum.	Common chokecherry	Eastern redcedar, ponderosa pine, Austrian pine, honeylocust, Scotch pine, green ash, hackberry.	Siberian elm------	Eastern cottonwood.
At----------------- Attica	Lilac, American plum.	Common chokecherry	Eastern redcedar, Russian mulberry, ponderosa pine, Scotch pine, honeylocust, Austrian pine, green ash, hackberry.	Siberian elm------	---
Ax*:					
Attica-----------	Lilac, American plum.	Common chokecherry	Eastern redcedar, Russian mulberry, ponderosa pine, Scotch pine, honeylocust, Austrian pine, green ash, hackberry.	Siberian elm------	---
Carwile----------	American plum-----	Amur honeysuckle, lilac.	Eastern redcedar, Austrian pine, ponderosa pine, green ash, Russian-olive, Russian mulberry.	Honeylocust, hackberry.	Eastern cottonwood.
Ca----------------- Canadian	American plum-----	Amur honeysuckle, lilac.	Eastern redcedar, Austrian pine, ponderosa pine, green ash, Russian-olive, Russian mulberry.	Honeylocust, hackberry.	Eastern cottonwood.
Cc----------------- Carwile	American plum-----	Amur honeysuckle, lilac.	Eastern redcedar, Austrian pine, ponderosa pine, green ash, Russian-olive, Russian mulberry.	Honeylocust, hackberry.	Eastern cottonwood.
Ce, Cf------------ Case	Fragrant sumac, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, Rocky Mountain juniper, Russian-olive.	Honeylocust, Siberian elm, ponderosa pine, green ash, black locust, osageorange.	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Cg*:					
Case	Fragrant sumac, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, Rocky Mountain juniper, Russian-olive.	Honeylocust, Siberian elm, ponderosa pine, green ash, black locust, osageorange.	---	---
Canlon.					
Ck, Cm: Clark	Silver buffaloberry, fragrant sumac, Siberian pea-shrub, Tatarian honeysuckle.	Eastern redcedar, Rocky Mountain juniper, Russian-olive, bur oak.	Green ash, Siberian elm, ponderosa pine, honeylocust.	---	---
Co: Coly	Silver buffaloberry, fragrant sumac, Siberian pea-shrub, Tatarian honeysuckle.	Eastern redcedar, Rocky Mountain juniper, bur oak, Russian-olive.	Green ash, ponderosa pine, honeylocust, Siberian elm.	---	---
Cp. Coly					
Ct*: Coly.					
Tobin	American plum	Lilac, Amur honeysuckle.	Eastern redcedar, Russian-olive, Austrian pine, green ash, ponderosa pine, Russian mulberry.	Hackberry, honeylocust.	Eastern cottonwood.
Da: Dale	American plum	Amur honeysuckle, lilac.	Eastern redcedar, ponderosa pine, Austrian pine, green ash, Russian-olive, Russian mulberry.	Honeylocust, hackberry.	Eastern cottonwood.
Fa, Fb: Farnum	Lilac, fragrant sumac, Amur honeysuckle.	Russian mulberry	Eastern redcedar, Austrian pine, hackberry, honeylocust, bur oak, green ash, Russian-olive.	Siberian elm	---
Ha, Hb: Harney	Amur honeysuckle, lilac, fragrant sumac.	Russian mulberry	Eastern redcedar, bur oak, honeylocust, Russian-olive, Austrian pine, green ash, hackberry.	Siberian elm	---
He*: Hedville.					
Rock outcrop.					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
Ho, Hp: Holdrege	Lilac, Amur honeysuckle, fragrant sumac.	Russian mulberry	Eastern redcedar, Austrian pine, green ash, honeylocust, hackberry, bur oak, Russian-olive.	Siberian elm	---
Kr: Krier	Silver buffaloberry, lilac, Tatarian honeysuckle.	Eastern redcedar, Rocky Mountain juniper, green ash, Russian-olive, Siberian peashrub.	Golden willow, Siberian elm.	---	Eastern cottonwood.
Lh*:					
Lancaster	Fragrant sumac, lilac, Siberian peashrub.	Rocky Mountain juniper, Russian mulberry, Russian-olive.	Eastern redcedar, green ash, Austrian pine, bur oak, honeylocust.	Siberian elm	---
Hedville.					
Ln: Lincoln	Lilac, American plum.	Eastern redcedar, common chokecherry.	Ponderosa pine, Austrian pine, honeylocust, green ash.	Siberian elm	---
Na, Nb: Naron	Lilac, American plum.	Common chokecherry	Eastern redcedar, ponderosa pine, hackberry, Russian mulberry, green ash, honeylocust, Austrian pine, Scotch pine.	Siberian elm	---
Ne. Ness					
Nw: New Cambria	---	Siberian peashrub, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, Russian-olive, ponderosa pine, green ash, Russian mulberry.	Siberian elm, hackberry, honeylocust.	Eastern cottonwood.
Oe: Owens	Amur honeysuckle, Siberian peashrub, Peking cotoneaster.	Eastern redcedar, Rocky Mountain juniper, hackberry, green ash, Russian-olive.	Honeylocust	---	---
Pe: Plevna	American plum, redosier dogwood.	Common chokecherry	Green ash, eastern redcedar, hackberry, Russian mulberry, Austrian pine.	Golden willow, honeylocust.	Eastern cottonwood.
Pr, Ps: Pratt	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine.	---	---
Pt*:					
Pratt	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine.	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
Pt*:					
Tivoli	Lilac, Amur honeysuckle, skunkbush sumac.	Rocky Mountain juniper, American plum, redbud.	Eastern redcedar, oriental arborvitae, osageorange, black locust, red mulberry.	---	---
Qw*:					
Quinlan	Skunkbush sumac, lilac, Amur honeysuckle.	Rocky Mountain juniper, redbud.	Eastern redcedar, oriental arborvitae.	---	---
Woodward	Fragrant sumac, lilac, Siberian peashrub.	Russian-olive, Austrian pine, Russian mulberry.	Rocky Mountain juniper, bur oak, green ash, eastern redcedar, honeylocust.	Siberian elm	---
Sh Shellabarger	Lilac, American plum.	Common chokecherry	Eastern redcedar, ponderosa pine, Austrian pine, honeylocust, Scotch pine, green ash, hackberry.	Siberian elm	Eastern cottonwood.
Th Tivoli	Lilac, Amur honeysuckle, skunkbush sumac.	Rocky Mountain juniper, American plum, redbud.	Eastern redcedar, oriental arborvitae, osageorange, black locust, red mulberry.	---	---
To, Ts Tobin	American plum	Lilac, Amur honeysuckle.	Eastern redcedar, Russian-olive, Austrian pine, green ash, ponderosa pine, Russian mulberry.	Hackberry, honeylocust.	Eastern cottonwood.
Uc Uly	Amur honeysuckle, lilac.	Common choke-cherry, Russian mulberry.	Eastern redcedar, green ash, Russian-olive, honeylocust, Austrian pine, hackberry, bur oak.	Siberian elm	---
Wa Waldeck	---	Siberian peashrub, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, Russian mulberry, ponderosa pine, green ash, Russian-olive.	Hackberry, Siberian elm, honeylocust.	Eastern cottonwood.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
An: Albion	Slight	Slight	Moderate: slope, small stones.	Slight.
As*:				
Albion	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Shellabarger	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
At: Attica	Slight	Slight	Moderate: slope.	Slight.
Ax*:				
Attica	Slight	Slight	Moderate: slope.	Slight.
Carwile	Severe: ponding, wetness.	Severe: ponding, wetness.	Severe: ponding, wetness.	Severe: ponding, wetness.
Ca: Canadian	Severe: flooding.	Slight	Slight	Slight.
Cc: Carwile	Severe: ponding, wetness.	Severe: ponding, wetness.	Severe: ponding, wetness.	Severe: ponding, wetness.
Ce: Case	Slight	Slight	Moderate: slope.	Slight.
Cf: Case	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Cg*:				
Case	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Canlon	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock, small stones.	Slight.
Ck, Cm: Clark	Slight	Slight	Moderate: slope.	Slight.
Co: Coly	Slight	Slight	Severe: slope.	Slight.
Cp: Coly	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
Ct*:				
Coly	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
Tobin	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
Da: Dale	Severe: flooding.	Slight	Slight	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Fa: Farnum	Slight	Slight	Slight	Slight.
Fb: Farnum	Slight	Slight	Moderate: slope.	Slight.
Ha: Harney	Slight	Slight	Slight	Slight.
Hb: Harney	Slight	Slight	Moderate: slope.	Slight.
He*:				
Hedville	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones.	Moderate: slope.
Rock outcrop.				
Ho: Holdrege	Slight	Slight	Slight	Slight.
Hp: Holdrege	Slight	Slight	Moderate: slope.	Slight.
Kr: Krier	Severe: flooding, wetness.	Moderate: wetness, excess salt.	Severe: wetness.	Moderate: wetness.
Lh*:				
Lancaster	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Hedville	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones.	Slight.
Ln: Lincoln	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Na: Naron	Slight	Slight	Slight	Slight.
Nb: Naron	Slight	Slight	Moderate: slope.	Slight.
Ne: Ness	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Nw: New Cambria	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
Oe: Owens	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.
Pe: Plevna	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.
Pr: Pratt	Slight	Slight	Moderate: slope.	Slight.
Ps: Pratt	Slight	Slight	Severe: slope.	Slight.
Pt*:				
Pratt	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Pt*:				
Tivoli	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Qw*:				
Quinlan	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
Woodward	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
Sh Shellabarger	Slight	Slight	Moderate: slope.	Slight.
Th Tivoli	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
To Tobin	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
Ts Tobin	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Uc Uly	Slight	Slight	Moderate: slope.	Slight.
Wa Waldeck	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
An------------------ Albion	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
As*:									
Albion------------	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Shellabarger------	Poor	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
At------------------ Attica	Fair	Fair	Good	Fair	Poor	Very poor	Fair	Very poor	Fair.
Ax*:									
Attica------------	Fair	Fair	Good	Fair	Poor	Very poor	Fair	Very poor	Fair.
Carwile-----------	Fair	Good	Good	Good	Good	Fair	Good	Fair	Good.
Ca------------------ Canadian	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Cc------------------ Carwile	Fair	Good	Good	Good	Good	Fair	Good	Fair	Good.
Ce------------------ Case	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Cf------------------ Case	Poor	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Cg*:									
Case--------------	Poor	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Canlon------------	Poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Ck------------------ Clark	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Cm------------------ Clark	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Co------------------ Coly	Fair	Good	Good	Fair	Poor	Very poor	Fair	Very poor	Fair.
Cp------------------ Coly	Very poor	Very poor	Poor	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Ct*:									
Coly--------------	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Tobin-------------	Good	Good	Good	Good	Poor	Fair	Good	Poor	Good.
Da------------------ Dale	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
Fa, Fb-------------- Farnum	Good	Good	Good	Good	Poor	Poor	Good	Poor	Good.
Ha, Hb-------------- Harney	Good	Good	Good	Good	Poor	Fair	Good	Poor	Good.
He*:									
Hedville----------	Very poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
He*: Rock outcrop.									
Ho, Hp------------- Holdrege	Good	Good	Fair	Fair	Very poor	Very poor	Good	Very poor	Fair.
Kr----------------- Krier	Poor	Poor	Fair	Poor	Good	Good	Poor	Good	Poor.
Lh*:									
Lancaster---------	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Hedville----------	Very poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Ln----------------- Lincoln	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Na, Nb------------- Naron	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Ne----------------- Ness	Poor	Poor	Poor	Poor	Fair	Good	Poor	Good	Poor.
Nw----------------- New Cambria	Fair	Fair	Poor	Fair	Poor	Poor	Fair	Poor	Poor.
Oe----------------- Owens	Poor	Fair	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
Pe----------------- Plevna	Poor	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.
Pr, Ps------------- Pratt	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Pt*:									
Pratt-------------	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Tivoli------------	Poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Qw*:									
Quinlan-----------	Poor	Poor	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
Woodward----------	Fair	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
Sh----------------- Shellabarger	Fair	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Th----------------- Tivoli	Poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
To----------------- Tobin	Good	Good	Good	Good	Poor	Fair	Good	Poor	Good.
Ts----------------- Tobin	Fair	Good	Good	Fair	Poor	Very poor	Fair	Very poor	Fair.
Uc----------------- Uly	Fair	Good	Good	Fair	Very poor	Very poor	Fair	Very poor	Good.
Wa----------------- Waldeck	Fair	Good	Good	Good	Fair	Fair	Good	Fair	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
An: Albion	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
As*:					
Albion	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Shellabarger	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
At: Attica	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Ax*:					
Attica	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Carwile	Severe: ponding, wetness.	Severe: shrink-swell, ponding, wetness.	Severe: shrink-swell, ponding, wetness.	Severe: shrink-swell, ponding, wetness.	Severe: wetness, shrink-swell, ponding.
Ca: Canadian	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
Cc: Carwile	Severe: ponding, wetness.	Severe: shrink-swell, ponding, wetness.	Severe: shrink-swell, ponding, wetness.	Severe: shrink-swell, ponding, wetness.	Severe: wetness, shrink-swell, ponding.
Ce: Case	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Cf: Case	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
Cg*:					
Case	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
Canlon	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
Ck: Clark	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Cm: Clark	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Co: Coly	Slight	Slight	Slight	Moderate: slope.	Slight.
Cp: Coly	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Ct*:					
Coly	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Tobin	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
Da Dale	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: shrink-swell, flooding.
Fa, Fb Farnum	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Ha, Hb Harney	Moderate: too clayey.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength.
He*:					
Hedville	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.
Rock outcrop.					
Ho, Hp Holdrege	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Kr Krier	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding.
Lh*:					
Lancaster	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Moderate: low strength, slope, frost action.
Hedville	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.
Ln Lincoln	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Na, Nb Naron	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Ne Ness	Severe: cutbanks cave, ponding.	Severe: ponding, shrink-swell.	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.
Nw New Cambria	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.
Oe Owens	Severe: slope, depth to rock.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell, depth to rock.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.
Pe Plevna	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Pr: Pratt	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Ps: Pratt	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
Pt*:					
Pratt	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Tivoli	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Qw*:					
Quinlan	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Woodward	Moderate: depth to rock, slope.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.
Sh: Shellabarger	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
Th: Tivoli	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
To, Ts: Tobin	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
Uc: Uly	Slight	Slight	Slight	Moderate: slope.	Severe: low strength.
Wa: Waldeck	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
An: Albion	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
As*:					
Albion	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Shellabarger	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Poor: thin layer.
At: Attica	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
Ax*:					
Attica	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
Carwile	Severe: percs slowly, ponding, wetness.	Severe: ponding, wetness.	Severe: ponding, too clayey, wetness.	Severe: ponding, wetness.	Poor: ponding, too clayey, hard to pack.
Ca: Canadian	Moderate: flooding.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
Cc: Carwile	Severe: percs slowly, ponding, wetness.	Severe: ponding, wetness.	Severe: ponding, too clayey, wetness.	Severe: ponding, wetness.	Poor: ponding, too clayey, hard to pack.
Ce: Case	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Cf: Case	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Cg*:					
Case	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Canlon	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Ck, Cm: Clark	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Co: Coly	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
Cp: Coly	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ct*:					
Coly	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Tobin	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Da Dale	Moderate: flooding.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
Fa Farnum	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
Fb Farnum	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Ha Harney	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
Hb Harney	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
He*:					
Hedville	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, small stones, slope.
Rock outcrop.					
Ho Holdrege	Slight	Moderate: seepage.	Slight	Slight	Good.
Hp Holdrege	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
Kr Krier	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
Lh*:					
Lancaster	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Hedville	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.
Ln Lincoln	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage.	Poor: seepage, too sandy.
Na, Nb Naron	Slight	Severe: seepage.	Severe: seepage.	Slight	Fair: thin layer.
Ne Ness	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: hard to pack, ponding.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Nw: New Cambria	Severe: percs slowly.	Slight	Severe: too clayey.	Moderate: flooding.	Poor: too clayey, hard to pack.
Oe: Owens	Severe: percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: slope, too clayey, depth to rock.	Severe: slope, depth to rock.	Poor: too clayey, hard to pack, area reclaim.
Pe: Plevna	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness.
Pr: Pratt	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: thin layer.
Ps: Pratt	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: thin layer.
Pt*:					
Pratt	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: thin layer.
Tivoli	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Qw*:					
Quinlan	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
Woodward	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Sh: Shellabarger	Slight	Moderate: seepage, slope.	Slight	Slight	Poor: thin layer.
Th: Tivoli	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
To, Ts: Tobin	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Uc: Uly	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
Wa: Waldeck	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Fair: wetness, thin layer.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
An-------------------- Albion	Good	Probable	Probable	Poor: small stones, area reclaim.
As*:				
Albion	Good	Probable	Probable	Poor: small stones, area reclaim.
Shellabarger	Good	Probable	Improbable: too sandy.	Fair: small stones, area reclaim.
At-------------------- Attica	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
Ax*:				
Attica	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
Carwile	Poor: shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Ca-------------------- Canadian	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Cc-------------------- Carwile	Poor: shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Ce-------------------- Case	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Cf-------------------- Case	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
Cg*:				
Case	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
Canlon	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
Ck, Cm---------------- Clark	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Co-------------------- Coly	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Cp-------------------- Coly	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Ct*:				
Coly	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Tobin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Da: Dale	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
Fa, Fb: Farnum	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Ha, Hb: Harney	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
He*:				
Hedville	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Rock outcrop.				
Ho, Hp: Holdrege	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Kr: Krier	Fair: wetness.	Probable	Improbable: too sandy.	Poor: thin layer.
Lh*:				
Lancaster	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer, slope.
Hedville	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
Ln: Lincoln	Good	Probable	Improbable: too sandy.	Good.
Na, Nb: Naron	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Ne: Ness	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Nw: New Cambria	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Oe: Owens	Poor: low strength, shrink-swell, area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope, area reclaim.
Pe: Plevna	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
Pr, Ps: Pratt	Good	Probable	Improbable: too sandy.	Fair: too sandy.
Pt*:				
Pratt	Good	Probable	Improbable: too sandy.	Fair: too sandy, slope.
Tivoli	Good	Probable	Improbable: too sandy.	Poor: too sandy.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Qw*:				
Quinlan	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
Woodward	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, area reclaim.
Sh: Shellabarger	Good	Probable	Improbable: too sandy.	Fair: small stones, area reclaim.
Th: Tivoli	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
To, Ts: Tobin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Uc: Uly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Wa: Waldeck	Fair: wetness.	Probable	Improbable: too sandy.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
An----------------- Albion	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
As*:						
Albion------------	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Slope, too sandy, soil blowing.	Slope, droughty.
Shellabarger------	Severe: slope.	Severe: thin layer.	Deep to water	Slope-----------	Slope, soil blowing.	Slope.
At----------------- Attica	Severe: seepage.	Severe: piping.	Deep to water	Fast intake, soil blowing.	Soil blowing---	Favorable.
Ax*:						
Attica------------	Severe: seepage.	Severe: piping.	Deep to water	Fast intake, soil blowing.	Soil blowing---	Favorable.
Carwile-----------	Moderate: seepage.	Severe: ponding, hard to pack, wetness.	Percs slowly, ponding.	Ponding, wetness, soil blowing.	Percs slowly, ponding, soil blowing.	Percs slowly, wetness.
Ca----------------- Canadian	Severe: seepage.	Severe: piping.	Deep to water	Favorable------	Favorable------	Favorable.
Cc----------------- Carwile	Moderate: seepage.	Severe: ponding, hard to pack, wetness.	Percs slowly, ponding.	Ponding, wetness, soil blowing.	Percs slowly, ponding, soil blowing.	Percs slowly, wetness.
Ce----------------- Case	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope-----------	Favorable------	Favorable.
Cf----------------- Case	Severe: slope.	Moderate: piping.	Deep to water	Slope-----------	Slope-----------	Slope.
Cg*:						
Case--------------	Severe: slope.	Moderate: piping.	Deep to water	Slope-----------	Slope-----------	Slope.
Canlon------------	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Depth to rock, slope.	Slope, depth to rock.
Ck----------------- Clark	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable------	Favorable------	Favorable.
Cm----------------- Clark	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope-----------	Favorable------	Favorable.
Co----------------- Coly	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
Cp----------------- Coly	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Ct*:						
Coly--------------	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Ct*:						
Tobin	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding	Favorable	Favorable.
Da Dale	Moderate: seepage.	Moderate: piping.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
Fa, Fb Farnum	Moderate: seepage.	Severe: thin layer.	Deep to water	Favorable	Favorable	Favorable.
Ha, Hb Harney	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
He*:						
Hedville	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Rock outcrop.						
Ho, Hp Holdrege	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Kr Krier	Severe: seepage.	Severe: seepage, piping, wetness.	Flooding, cutbanks cave, excess salt.	Wetness, droughty, soil blowing.	Wetness, too sandy, soil blowing.	Wetness, excess salt, droughty.
Lh*:						
Lancaster	Severe: slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Hedville	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Ln Lincoln	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, flooding.	Too sandy	Droughty, soil blowing, flooding.
Na, Nb Naron	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Soil blowing	Soil blowing	Favorable.
Ne Ness	Moderate: seepage.	Severe: piping, hard to pack, ponding.	Ponding, percs slowly.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
Nw New Cambria	Slight	Severe: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly	Percs slowly.
Oe Owens	Severe: slope, depth to rock.	Severe: thin layer.	Deep to water	Droughty, slow intake, percs slowly.	Slope, erodes easily, depth to rock.	Slope, erodes easily, droughty.
Pe Plevna	Severe: seepage.	Severe: piping, wetness.	Flooding	Wetness, flooding, soil blowing.	Wetness, soil blowing.	Wetness.
Pr, Ps Pratt	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Pt*:						
Pratt	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Pt*:						
Tivoli	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Qw*:						
Quinlan	Severe: depth to rock, slope.	Severe: piping, thin layer.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Woodward	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily, depth to rock.	Depth to rock, erodes easily, slope.	Slope, depth to rock, erodes easily.
Sh Shellabarger	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Slope	Favorable	Favorable.
Th Tivoli	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
To, Ts Tobin	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding	Favorable	Favorable.
Uc Uly	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Wa Waldeck	Severe: seepage.	Severe: piping.	Flooding	Wetness, flooding.	Wetness	Favorable.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
An--------------- Albion	0-11	Sandy loam-------	SM, ML, CL-ML, SM-SC	A-2, A-4	0	100	75-100	60-90	25-55	<30	NP-5
	11-24	Sandy loam, loam	SM, ML, CL, CL-ML	A-2, A-4	0	85-100	75-100	45-90	30-55	20-35	NP-10
	24-60	Loamy sand, gravelly sand, sand.	SP-SM, GP-GM, SM, GM	A-2, A-1, A-3	0-5	40-100	40-90	30-70	5-30	<30	NP-5
As*: Albion-----------	0-11	Sandy loam-------	SM, ML, CL-ML, SM-SC,	A-2, A-4	0	100	75-100	60-90	25-55	<30	NP-5
	11-24	Sandy loam, loam	SM, ML, CL, CL-ML	A-2, A-4	0	85-100	75-100	45-90	30-55	20-35	NP-10
	24-60	Loamy sand, gravelly sand, sand.	SP-SM, GP-GM, SM, GM	A-2, A-1, A-3	0-5	40-100	40-90	30-70	5-30	<30	NP-5
Shellabarger----	0-12	Sandy loam-------	SM, ML	A-4, A-2	0	95-100	95-100	75-100	30-55	<30	NP-5
	12-60	Sandy clay loam, sandy loam, fine sandy loam.	SC	A-4, A-6	0	95-100	85-100	70-90	35-50	25-40	8-20
At--------------- Attica	0-10	Loamy fine sand	SM, SP-SM	A-2	0	100	95-100	70-100	10-35	---	NP
	10-30	Fine sandy loam, sandy loam.	SM, ML, SM-SC, CL-ML	A-2, A-4	0	100	95-100	75-100	30-55	<26	NP-7
	30-60	Fine sandy loam, loamy fine sand.	SM, SM-SC	A-2, A-4	0	85-100	80-100	70-100	20-50	<26	NP-7
Ax*: Attica----------	0-10	Loamy fine sand	SM, SP-SM	A-2	0	100	95-100	70-100	10-35	---	NP
	10-30	Fine sandy loam, sandy loam.	SM, ML, SM-SC, CL-ML	A-2, A-4	0	100	95-100	75-100	30-55	<26	NP-7
	30-60	Fine sandy loam, loamy fine sand.	SM, SM-SC	A-2, A-4	0	85-100	80-100	70-100	20-50	<26	NP-7
Carwile---------	0-15	Fine sandy loam	ML, SM, CL-ML, SM-SC	A-4	0	100	98-100	90-100	36-60	<26	NP-7
	15-36	Clay loam, clay, sandy clay.	CL, CH, SC	A-6, A-7	0	100	100	90-100	40-95	35-70	14-38
	36-60	Clay loam, sandy clay loam, clay.	CL, CH, SC	A-4, A-6, A-7	0	100	100	90-100	36-95	25-70	7-38
Ca--------------- Canadian	0-14	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4	0	100	98-100	94-100	36-65	<26	NP-7
	14-60	Fine sandy loam, loam, sandy loam.	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-85	<31	NP-10
Cc--------------- Carwile	0-15	Fine sandy loam	ML, SM, CL-ML, SM-SC	A-4	0	100	98-100	90-100	36-60	<26	NP-7
	15-36	Clay loam, clay, sandy clay.	CL, CH, SC	A-6, A-7	0	100	100	90-100	40-95	35-70	14-38
	36-60	Clay loam, sandy clay loam, clay.	CL, CH, SC	A-4, A-6, A-7	0	100	100	90-100	36-95	25-70	7-38
Ce, Cf----------- Case	0-6	Clay loam--------	CL, CL-ML	A-4, A-6	0	90-100	90-100	85-100	55-85	20-40	5-20
	6-60	Clay loam, loam	CL	A-6, A-7-6	0	90-100	90-100	85-100	55-85	25-45	10-25

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Cg*:											
Case	0-6	Clay loam	CL, CL-ML	A-4, A-6	0	90-100	90-100	85-100	55-85	20-40	5-20
	6-60	Clay loam, loam	CL	A-6, A-7-6	0	90-100	90-100	85-100	55-85	25-45	10-25
Canlon	0-5	Loam	CL, CL-ML	A-4, A-6	0	90-100	75-100	65-100	50-90	20-40	4-20
	5-14	Loam, gravelly loam, fine sandy loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0	75-100	55-100	50-95	35-85	20-40	4-20
	14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Ck Clark	0-5	Loam	CL-ML, CL	A-4, A-6	0	100	95-100	90-100	50-90	20-40	5-20
	5-60	Loam, clay loam, very fine sandy loam.	CL	A-6	0	100	95-100	90-100	55-90	25-40	10-25
Cm Clark	0-10	Loam	CL-ML, CL	A-4, A-6	0	100	95-100	90-100	50-90	20-40	5-20
	10-60	Loam, clay loam, very fine sandy loam.	CL	A-6	0	100	95-100	90-100	55-90	25-40	10-25
Co, Cp Coly	0-5	Silt loam	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	85-100	20-40	2-15
	5-60	Silt loam, very fine sandy loam, loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	85-100	20-40	2-15
Ct*:											
Coly	0-5	Silt loam	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	85-100	20-40	2-15
	5-60	Silt loam, very fine sandy loam, loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	85-100	20-40	2-15
Tobin	0-25	Silt loam	CL	A-4, A-6	0	100	100	95-100	90-100	25-35	8-15
	25-60	Silt loam, silty clay loam, loam.	CL	A-4, A-6, A-7-6	0	100	100	95-100	90-100	25-45	8-20
Da Dale	0-16	Silt loam	CL, CL-ML	A-4, A-6	0	95-100	95-100	90-100	65-98	25-35	5-15
	16-60	Silt loam, loam, silty clay loam.	CL	A-4, A-6, A-7-6	0	95-100	95-100	90-100	65-98	30-43	8-20
Fa Farnum	0-11	Loam	CL-ML, CL	A-4, A-6	0	100	100	90-100	60-85	20-35	5-15
	11-54	Clay loam, sandy clay loam.	SC, CL	A-6, A-7-6	0	100	100	70-100	45-80	35-50	15-30
	54-60	Loam, clay loam, fine sandy loam.	SC, CL, SM-SC, CL-ML	A-6, A-2, A-4	0	100	95-100	65-100	30-80	20-35	5-15
Fb Farnum	0-11	Loam	CL-ML, CL	A-4, A-6	0	100	100	90-100	60-85	20-35	5-15
	11-51	Clay loam, sandy clay loam.	SC, CL	A-6, A-7-6	0	100	100	70-100	45-80	35-50	15-30
	51-60	Loam, clay loam, fine sandy loam.	SC, CL, SM-SC, CL-ML	A-6, A-2, A-4	0	100	95-100	65-100	30-80	20-35	5-15
Ha, Hb Harney	0-5	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
	5-28	Silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	85-100	40-60	15-35
	28-60	Silty clay loam, silt loam.	CL	A-6, A-7-6	0	100	100	95-100	85-100	30-45	10-20
He*:											
Hedville	0-11	Fine sandy loam	SM, ML, SC, CL	A-4, A-6	0-15	70-100	70-100	50-85	35-70	<35	NP-13
	11	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
He*: Rock outcrop.											
Ho, Hp------------ Holdrege	0-10	Silt loam---------	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	20-40	2-18
	10-27	Silty clay loam	CL	A-7-6, A-6	0	100	100	98-100	90-100	30-50	15-35
	27-32	Silt loam, silty clay loam.	CL	A-6, A-4	0	100	100	95-100	95-100	25-40	9-17
	32-60	Silt loam---------	CL, ML	A-4, A-6	0	100	100	95-100	90-100	30-40	5-15
Kr---------------- Krier	0-5	Sandy loam--------	SM	A-2, A-4	0	100	95-100	70-100	20-50	<20	NP-4
	5-11	Loam, clay loam, sandy loam.	CL, CL-ML, SM, SM-SC	A-2, A-4, A-6	0	100	95-100	70-100	20-85	20-40	2-20
	11-60	Sand, fine sand, loamy sand.	SM, SP-SM	A-2, A-3	0	100	95-100	55-75	5-35	---	NP
Lh*: Lancaster--------	0-13	Loam--------------	CL-ML, CL	A-4, A-6	0-5	95-100	90-100	85-100	60-90	20-35	5-15
	13-23	Clay loam, loam, sandy clay loam.	CL-ML, SC, SM-SC, CL	A-4, A-6	0-10	95-100	90-100	80-100	36-80	20-35	5-15
	23	Weathered bedrock	---	---	---	---	---	---	---	---	---
Hedville---------	0-11	Fine sandy loam	SM, ML, SC, CL	A-4, A-6	0-15	70-100	70-100	50-85	35-70	<35	NP-13
	11	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Ln---------------- Lincoln	0-8	Sandy loam--------	ML, CL, SC, SM	A-4, A-6	0	100	98-100	94-100	36-90	<40	NP-18
	8-60	Stratified sand to clay loam.	SM, SP-SM	A-2, A-3	0	100	98-100	82-100	5-35	---	NP
Na, Nb------------ Naron	0-10	Fine sandy loam	SM, SM-SC, ML, CL-ML	A-2, A-4	0	100	95-100	75-100	25-60	<26	1-7
	10-48	Fine sandy loam, sandy clay loam, sandy loam.	SC, CL	A-4, A-6	0	100	95-100	80-100	36-60	26-40	8-18
	48-60	Fine sandy loam, loamy fine sand, fine sand.	SM, SM-SC	A-2, A-4	0	100	95-100	75-100	20-50	<26	NP-7
Ne---------------- Ness	0-38	Silty clay--------	CH	A-7	0	100	100	95-100	90-100	50-70	30-45
	38-60	Silty clay loam, silt loam.	CL, CH	A-6, A-7, A-4	0	100	100	95-100	90-100	30-55	8-30
Nw---------------- New Cambria	0-12	Silty clay--------	CH	A-7	0	100	100	95-100	90-100	50-75	30-45
	12-36	Silty clay, silty clay loam, clay.	CH	A-7	0	100	100	95-100	85-100	50-75	25-45
	36-60	Silty clay, silty clay loam, clay.	CH, CL	A-7	0	100	100	95-100	85-100	40-60	20-40
Oe---------------- Owens	0-6	Clay--------------	CL, CH	A-7	0-5	95-100	95-100	85-100	75-95	45-60	22-32
	6-15	Clay, clay loam, silty clay.	CL, CH	A-7	0-5	95-100	90-100	85-100	75-95	45-66	22-40
	15	Weathered bedrock	---	---	---	---	---	---	---	---	---
Pe---------------- Plevna	0-9	Loam--------------	SM, SM-SC	A-2, A-4	0	100	95-100	70-100	20-50	<26	NP-6
	9-48	Fine sandy loam, sandy loam.	SM, SM-SC	A-2, A-4	0	100	95-100	70-100	30-50	<26	NP-6
	48-60	Fine sand, sand, loamy sand.	SM, SP, SP-SM	A-2, A-3	0	100	90-100	50-90	4-35	---	NP
Pr, Ps------------ Pratt	0-12	Loamy fine sand	SM	A-2	0	100	95-100	70-100	15-35	---	NP
	12-36	Loamy fine sand, loamy sand, fine sandy loam.	SM, SM-SC	A-2, A-4	0	100	95-100	90-100	15-40	<20	NP-6
	36-60	Loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Pt*:											
Pratt-----------	0-10	Loamy fine sand	SM	A-2	0	100	95-100	70-100	15-35	---	NP
	10-32	Loamy fine sand, loamy sand, fine sandy loam.	SM, SM-SC	A-2, A-4	0	100	95-100	90-100	15-40	<20	NP-6
	32-60	Loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
Tivoli----------	0-7	Loamy fine sand	SM	A-2	0	100	95-100	90-100	15-35	---	NP
	7-60	Fine sand, sand	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-25	---	NP
Qw*:											
Quinlan---------	0-15	Loam-------------	CL, ML, CL-ML	A-4, A-6	0	100	95-100	90-100	51-97	<37	NP-14
	15	Weathered bedrock	---	---	---	---	---	---	---	---	---
Woodward--------	0-27	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	51-95	<31	NP-12
	27	Weathered bedrock	---	---	---	---	---	---	---	---	---
Sh--------------- Shellabarger	0-11	Loam-------------	CL	A-4, A-6	0	95-100	95-100	80-95	55-75	25-35	7-15
	11-60	Sandy clay loam, sandy loam, fine sandy loam.	SC	A-4, A-6	0	95-100	85-100	70-90	35-50	25-40	8-20
Th--------------- Tivoli	0-6	Fine sand--------	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-25	---	NP
	6-60	Fine sand, sand	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-25	---	NP
To, Ts----------- Tobin	0-25	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	90-100	25-35	8-15
	25-60	Silt loam, silty clay loam, loam.	CL	A-4, A-6, A-7-6	0	100	100	95-100	90-100	25-45	8-20
Uc--------------- Uly	0-10	Silt loam--------	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	2-15
	10-22	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	100	95-100	25-40	3-15
	22-60	Silt loam, very fine sandy loam.	CL, ML, CL-ML	A-4, A-6	0	100	100	100	95-100	25-40	3-15
Wa--------------- Waldeck	0-14	Loam-------------	ML	A-4	0	100	95-100	75-100	50-60	<30	NP-7
	14-41	Fine sandy loam, sandy loam.	SM, SM-SC	A-2, A-4	0	100	95-100	70-100	30-50	<25	NP-5
	41-60	Fine sand, sand	SM, SP, SP-SM	A-1, A-2, A-3	0	90-100	80-100	40-60	1-35	---	NP

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cm3	In/hr	In/in	pH	mmhos/cm					Pct
An------- Albion	0-11	7-15	1.35-1.50	2.0-6.0	0.13-0.20	5.6-6.5	<2	Low-------	0.20	3	3	1-2
	11-24	10-18	1.45-1.60	2.0-6.0	0.12-0.18	6.1-7.8	<2	Low-------	0.20			
	24-60	2-10	1.50-1.65	6.0-20	0.03-0.10	6.1-8.4	<2	Low-------	0.15			
As*:												
Albion----------	0-11	7-15	1.35-1.50	2.0-6.0	0.13-0.20	5.6-6.5	<2	Low-------	0.20	3	3	1-2
	11-24	10-18	1.45-1.60	2.0-6.0	0.12-0.18	6.1-7.8	<2	Low-------	0.20			
	24-60	2-10	1.50-1.65	6.0-20	0.03-0.10	6.1-8.4	<2	Low-------	0.15			
Shellabarger----	0-12	8-16	1.35-1.50	0.6-2.0	0.13-0.21	5.1-6.5	<2	Low-------	0.20	5	3	1-2
	12-60	18-27	1.45-1.60	0.6-2.0	0.16-0.18	6.1-7.8	<2	Low-------	0.28			
At------- Attica	0-10	2-10	1.50-1.60	2.0-6.0	0.10-0.13	5.6-7.3	<2	Low-------	0.17	5	2	.5-1
	10-30	8-18	1.50-1.60	2.0-6.0	0.12-0.17	5.6-6.5	<2	Low-------	0.24			
	30-60	4-18	1.50-1.60	2.0-6.0	0.08-0.16	6.1-7.8	<2	Low-------	0.24			
Ax*:												
Attica----------	0-10	2-10	1.50-1.60	2.0-6.0	0.10-0.13	5.6-7.3	<2	Low-------	0.17	5	2	.5-1
	10-30	8-18	1.50-1.60	2.0-6.0	0.12-0.17	5.6-6.5	<2	Low-------	0.24			
	30-60	4-18	1.50-1.60	2.0-6.0	0.08-0.16	6.1-7.8	<2	Low-------	0.24			
Carwile---------	0-15	5-18	1.30-1.65	0.6-2.0	0.11-0.20	5.1-7.3	<2	Low-------	0.32	5	3	1-3
	15-36	35-60	1.35-1.75	0.06-0.2	0.12-0.20	6.1-8.4	<2	High------	0.37			
	36-60	20-45	1.35-1.75	0.2-2.0	0.12-0.20	6.6-8.4	<2	High------	0.32			
Ca------- Canadian	0-14	5-18	1.30-1.60	2.0-6.0	0.10-0.15	5.6-7.3	<2	Low-------	0.20	5	---	1-3
	14-60	10-18	1.40-1.70	2.0-6.0	0.10-0.20	6.1-8.4	<2	Low-------	0.20			
Cc------- Carwile	0-15	5-18	1.30-1.65	0.6-2.0	0.11-0.20	5.1-7.3	<2	Low-------	0.32	5	3	1-3
	15-36	35-60	1.35-1.75	0.06-0.2	0.12-0.20	6.1-8.4	<2	High------	0.37			
	36-60	20-45	1.35-1.75	0.2-2.0	0.12-0.20	6.6-8.4	<2	High------	0.32			
Ce, Cf------- Case	0-6	15-32	1.35-1.45	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low-------	0.32	5	4L	.5-2
	6-60	18-35	1.35-1.70	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.32			
Cg*:												
Case------------	0-6	15-32	1.35-1.45	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low-------	0.32	5	4L	.5-2
	6-60	18-35	1.35-1.70	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.32			
Canlon----------	0-5	12-27	1.30-1.45	0.6-2.0	0.15-0.24	7.4-8.4	<2	Low-------	0.32	2	4L	---
	5-14	8-27	1.35-1.50	0.6-2.0	0.15-0.22	7.4-8.4	<2	Low-------	0.32			
	14	---	---	---	---	---	---	----------	----			
Ck------- Clark	0-5	15-32	1.35-1.45	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.28	5	4L	1-2
	5-60	18-35	1.35-1.70	0.6-2.0	0.14-0.19	7.4-8.4	<2	Moderate	0.28			
Cm------- Clark	0-10	15-32	1.35-1.45	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.28	5	4L	1-2
	10-60	18-35	1.35-1.70	0.6-2.0	0.14-0.19	7.4-8.4	<2	Moderate	0.28			
Co, Cp------- Coly	0-5	18-24	1.30-1.50	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low-------	0.43	5	4L	1-2
	5-60	18-24	1.30-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low-------	0.43			
Ct*:												
Coly------------	0-5	18-24	1.30-1.50	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low-------	0.43	5	4L	1-2
	5-60	18-24	1.30-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low-------	0.43			
Tobin-----------	0-25	18-27	1.30-1.40	0.6-2.0	0.20-0.24	5.6-7.8	<2	Moderate	0.32	5	6	1-4
	25-60	18-35	1.35-1.50	0.6-2.0	0.17-0.20	7.4-8.4	<2	Moderate	0.32			
Da------- Dale	0-16	15-26	1.30-1.50	0.6-2.0	0.15-0.24	6.1-7.8	<2	Low-------	0.37	5	6	1-3
	16-60	18-35	1.40-1.70	0.6-2.0	0.15-0.24	7.4-8.4	<2	Moderate	0.37			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodi-bility group	Organic matter
									K	T		
	In	Pct	g/cm3	In/hr	In/in	pH	mmhos/cm					Pct
Fa---------------- Farnum	0-11	14-29	1.35-1.45	0.6-2.0	0.19-0.22	5.6-7.3	<2	Low--------	0.28	5	6	1-3
	11-54	25-35	1.40-1.50	0.6-2.0	0.15-0.19	6.1-8.4	<2	Moderate	0.28			
	54-60	12-29	1.40-1.55	0.6-2.0	0.13-0.16	6.6-8.4	<2	Low--------	0.28			
Fb---------------- Farnum	0-11	14-29	1.35-1.45	0.6-2.0	0.19-0.22	5.6-7.3	<2	Low--------	0.28	5	6	1-3
	11-51	25-35	1.40-1.50	0.6-2.0	0.15-0.19	6.1-8.4	<2	Moderate	0.28			
	51-60	12-29	1.40-1.55	0.6-2.0	0.13-0.16	6.6-8.4	<2	Low--------	0.28			
Ha, Hb------------ Harney	0-5	22-27	1.30-1.40	0.6-2.0	0.22-0.24	5.6-7.8	<2	Low--------	0.32	5	6	2-4
	5-28	35-42	1.35-1.50	0.2-0.6	0.12-0.19	6.1-8.4	<2	Moderate	0.43			
	28-60	24-35	1.20-1.35	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.43			
He*:												
Hedville---------	0-11	8-22	1.35-1.50	0.6-2.0	0.14-0.20	5.6-7.3	<2	Low--------	0.32	2	3	1-4
	11	---	---	---	---	---	---	-----------	----			
Rock outcrop.												
Ho, Hp------------ Holdrege	0-10	15-25	1.40-1.60	0.6-2.0	0.22-0.24	5.6-7.3	<2	Low--------	0.32	5	6	1-3
	10-27	28-35	1.20-1.40	0.6-2.0	0.18-0.20	6.6-7.8	<2	Moderate	0.43			
	27-32	18-30	1.30-1.50	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.43			
	32-60	15-20	1.40-1.60	0.6-2.0	0.20-0.22	7.4-8.4	<2	Moderate	0.43			
Kr---------------- Krier	0-5	6-12	1.35-1.45	2.0-6.0	0.13-0.17	7.4-9.0	2-8	Low--------	0.24	3	3	---
	5-11	10-32	1.40-1.50	2.0-6.0	0.13-0.18	7.9-9.0	4-16	Low--------	0.32			
	11-60	1-5	1.45-1.55	6.0-20	0.03-0.07	7.4-9.0	2-8	Low--------	0.15			
Lh*:												
Lancaster--------	0-13	12-26	1.35-1.45	0.6-2.0	0.17-0.22	5.6-6.5	<2	Low--------	0.28	4	6	1-4
	13-23	18-30	1.40-1.55	0.6-2.0	0.15-0.19	6.1-7.3	<2	Moderate	0.28			
	23	---	---	---	---	---	---	-----------	----			
Hedville---------	0-11	8-22	1.35-1.50	0.6-2.0	0.14-0.20	5.6-7.3	<2	Low--------	0.32	2	3	1-4
	11	---	---	---	---	---	---	-----------	----			
Ln---------------- Lincoln	0-8	10-26	1.35-1.50	6.0-20	0.02-0.15	7.4-8.4	<2	Low--------	0.17	5	3	<.5
	8-60	5-15	1.30-1.60	6.0-20	0.02-0.08	7.9-8.4	<2	Low--------	0.17			
Na, Nb------------ Naron	0-10	8-14	1.40-1.50	0.6-6.0	0.14-0.20	5.6-7.3	<2	Low--------	0.20	5	3	1-3
	10-48	18-27	1.45-1.55	0.6-2.0	0.15-0.18	5.6-7.8	<2	Low--------	0.32			
	48-60	2-14	1.50-1.60	2.0-6.0	0.10-0.15	6.1-8.4	<2	Low--------	0.32			
Ne---------------- Ness	0-38	40-60	1.30-1.45	<0.06	0.11-0.14	6.1-8.4	<2	High-------	0.28	5	4	1-3
	38-60	20-40	1.35-1.45	0.06-2.0	0.10-0.20	7.4-8.4	<2	Moderate	0.28			
Nw---------------- New Cambria	0-12	40-60	1.30-1.40	0.06-0.2	0.12-0.14	6.6-8.4	<2	High-------	0.28	5	4	2-4
	12-36	38-60	1.35-1.45	0.06-0.2	0.13-0.18	7.9-8.4	<2	High-------	0.28			
	36-60	30-50	1.35-1.45	0.06-0.6	0.12-0.16	7.9-8.4	<2	High-------	0.28			
Oe---------------- Owens	0-6	40-60	1.35-1.55	<0.06	0.13-0.17	7.9-8.4	<2	High-------	0.32	2	4	.5-2
	6-15	35-60	1.45-1.65	<0.06	0.13-0.17	7.9-8.4	<2	High-------	0.37			
	15	---	---	---	---	---	---	-----------	----			
Pe---------------- Plevna	0-9	8-18	1.40-1.50	2.0-6.0	0.14-0.20	6.6-8.4	<2	Low--------	0.20	5	5	---
	9-48	8-18	1.40-1.50	2.0-6.0	0.12-0.16	6.6-8.4	<2	Low--------	0.20			
	48-60	1-7	1.50-1.60	2.0-6.0	0.05-0.07	6.6-8.4	<2	Low--------	0.20			
Pr, Ps------------ Pratt	0-12	2-8	1.40-1.55	6.0-20	0.10-0.13	5.6-7.3	<2	Low--------	0.17	5	2	.5-1
	12-36	4-11	1.45-1.55	6.0-20	0.09-0.12	5.6-7.3	<2	Low--------	0.17			
	36-60	1-8	1.45-1.60	6.0-20	0.08-0.12	6.1-7.3	<2	Low--------	0.17			
Pt*:												
Pratt------------	0-10	2-8	1.40-1.55	6.0-20	0.10-0.13	5.6-7.3	<2	Low--------	0.17	5	2	.5-1
	10-32	4-11	1.45-1.55	6.0-20	0.09-0.12	5.6-7.3	<2	Low--------	0.17			
	32-60	1-8	1.45-1.60	6.0-20	0.08-0.12	6.1-7.3	<2	Low--------	0.17			
Tivoli-----------	0-7	5-10	1.35-1.50	6.0-20.0	0.07-0.11	6.1-7.8	<2	Low--------	0.17	5	2	<1
	7-60	1-10	1.50-1.70	6.0-20.0	0.02-0.08	6.1-8.4	<2	Low--------	0.17			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cm3	In/hr	In/in	pH	mmhos/cm					Pct
Qw*:												
Quinlan----------	0-15	15-27	1.30-1.55	0.6-2.0	0.13-0.24	7.4-8.4	<2	Low--------	0.32	2	4L	<1
	15	---	---	---	---	---	---	-----------	----			
Woodward---------	0-27	10-18	1.30-1.60	0.6-2.0	0.13-0.20	6.6-8.4	<2	Low--------	0.32	4	4L	.5-2
	27	---	---	---	---	---	---	-----------	----			
Sh----------------- Shellabarger	0-11	12-22	1.30-1.40	0.6-2.0	0.20-0.22	5.1-6.5	<2	Low--------	0.28	5	6	1-3
	11-60	18-27	1.45-1.60	0.6-2.0	0.16-0.18	6.1-7.8	<2	Low--------	0.28			
Th----------------- Tivoli	0-6	1-10	1.35-1.50	6.0-20.0	0.02-0.08	6.1-7.8	<2	Low--------	0.17	5	1	<1
	6-60	1-10	1.50-1.70	6.0-20.0	0.02-0.08	6.1-8.4	<2	Low--------	0.17			
To, Ts------------ Tobin	0-25	18-27	1.30-1.40	0.6-2.0	0.20-0.24	5.6-7.8	<2	Moderate	0.32	5	6	1-4
	25-60	18-35	1.35-1.50	0.6-2.0	0.17-0.20	7.4-8.4	<2	Moderate	0.32			
Uc----------------- Uly	0-10	17-27	1.20-1.30	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low--------	0.32	5	6	1-3
	10-22	20-30	1.20-1.30	0.6-2.0	0.18-0.22	6.6-8.4	<2	Low--------	0.43			
	22-60	18-27	1.10-1.20	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.43			
Wa----------------- Waldeck	0-14	10-18	1.40-1.55	2.0-6.0	0.18-0.20	7.4-8.4	<2	Low--------	0.28	5	5	1-3
	14-41	8-16	1.50-1.60	2.0-6.0	0.12-0.17	7.4-8.4	<2	Low--------	0.20			
	41-60	1-4	1.55-1.65	6.0-20	0.05-0.07	7.4-8.4	<2	Low--------	0.20			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In			
An---------------- Albion	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low.
As*:											
Albion-----------	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low.
Shellabarger-----	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Moderate.
At---------------- Attica	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low.
Ax*:											
Attica-----------	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low.
Carwile----------	D	None---------	---	---	+1-2.0	Apparent	Oct-Apr	>60	---	High------	Moderate.
Ca---------------- Canadian	B	Rare---------	---	---	>6.0	---	---	>60	---	Low-------	Low.
Cc---------------- Carwile	D	None---------	---	---	+1-2.0	Apparent	Oct-Apr	>60	---	High------	Moderate.
Ce, Cf------------ Case	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low.
Cg*:											
Case-------------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low.
Canlon-----------	D	None---------	---	---	>6.0	---	---	10-20	Hard	Low-------	Low.
Ck, Cm------------ Clark	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low.
Co, Cp------------ Coly	B	None---------	---	---	>6.0	---	---	>60	---	High------	Low.
Ct*:											
Coly-------------	B	None---------	---	---	>6.0	---	---	>60	---	High------	Low.
Tobin------------	B	Frequent-----	Very brief	Mar-Dec	>6.0	---	---	>60	---	Low-------	Low.
Da---------------- Dale	B	Rare---------	---	---	>6.0	---	---	>60	---	Moderate	Low.
Fa, Fb------------ Farnum	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low.
Ha, Hb------------ Harney	B	None---------	---	---	>6.0	---	---	>60	---	High------	Low.
He*:											
Hedville---------	D	None---------	---	---	>6.0	---	---	4-20	Hard	Low-------	Moderate.
Rock outcrop.											
Ho, Hp------------ Holdrege	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low.
Kr---------------- Krier	D	Occasional	Very brief	Mar-Jul	1.0-3.0	Apparent	Mar-Jun	>60	---	High------	Low.
Lh*:											
Lancaster--------	B	None---------	---	---	>6.0	---	---	20-40	Soft	Low-------	Moderate.
Hedville---------	D	None---------	---	---	>6.0	---	---	4-20	Hard	Low-------	Moderate.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	Uncoated steel	Concrete
					Ft			In			
Ln----------------- Lincoln	A	Occasional	Very brief to brief.	Apr-Oct	5.0-8.0	Apparent	Nov-May	>60	---	Low-------	Low.
Na, Nb------------ Naron	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low.
Ne----------------- Ness	D	None---------	---	---	+1-1.0	Perched	Mar-Jun	>60	---	High------	Low.
Nw----------------- New Cambria	C	Rare---------	---	---	>6.0	---	---	>60	---	High------	Low.
Oe----------------- Owens	D	None---------	---	---	>6.0	---	---	10-20	Soft	High------	Low.
Pe----------------- Plevna	D	Frequent-----	Brief to long.	Mar-Oct	0-2.0	Apparent	Jan-Dec	>60	---	High------	Low.
Pr, Ps------------ Pratt	A	None---------	---	---	>6.0	---	---	>60	---	Low-------	Moderate.
Pt*: Pratt-------------	A	None---------	---	---	>6.0	---	---	>60	---	Low-------	Moderate.
Tivoli------------	A	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low.
Qw*: Quinlan-----------	C	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	Low.
Woodward----------	B	None---------	---	---	>6.0	---	---	20-40	Soft	Low-------	Low.
Sh----------------- Shellabarger	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Moderate.
Th----------------- Tivoli	A	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low.
To----------------- Tobin	B	Frequent-----	Very brief	Mar-Dec	>6.0	---	---	>60	---	Low-------	Low.
Ts----------------- Tobin	B	Occasional	Very brief	Mar-Dec	>6.0	---	---	>60	---	Low-------	Low.
Uc----------------- Uly	B	None---------	---	---	>6.0	---	---	>60	---	High------	Low.
Wa----------------- Waldeck	C	Occasional	Brief------	Mar-Oct	2.0-4.0	Apparent	Oct-Apr	>60	---	Moderate	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--ENGINEERING INDEX TEST DATA

[LL means liquid limit; PI, plasticity index; MD, maximum dry density; and OM, optimum moisture]

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution							LL	PI	Moisture density	
			Percentage passing sieve--				Percentage smaller than--						
	AASHTO	Unified	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			MD	OM
										Pct		Lb/ft3	Pct
Coly silt loam: (S81KS-097-015)													
Ap----- 0 to 5	A-6	CL	100	100	98	87	44	17	9	32	12	107	15
AC----- 5 to 12	A-6	CL	100	100	99	90	46	23	14	36	15	105	17
C------ 12 to 60	A-6	CL	100	100	99	95	49	25	16	33	14	107	16
Owens clay: (S81KS-097-014)													
A------ 0 to 6	A-7-6	CH	100	100	91	82	63	32	11	60	30	91	25
Bw----- 6 to 15	A-7-6	CH	100	100	96	90	75	41	14	66	37	94	26
Tobin silt loam: (S81KS-097-010)													
A------ 8 to 25	A-6	CL	100	100	100	90	36	12	4	33	11	103	19
AC----- 25 to 33	A-6	CL	100	100	100	92	41	17	9	32	12	106	17
C------ 33 to 60	A-6	CL	100	100	100	94	41	17	9	31	11	108	16

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Albion	Coarse-loamy, mixed, thermic Udic Argiustolls
Attica	Coarse-loamy, mixed, thermic Udic Haplustalfs
Canadian	Coarse-loamy, mixed, thermic Udic Haplustolls
Canlon	Loamy, mixed (calcareous), mesic Lithic Ustorthents
Carwile	Fine, mixed, thermic Typic Argiaquolls
Case	Fine-loamy, mixed, thermic Typic Ustochrepts
Clark	Fine-loamy, mixed, thermic Typic Calciustolls
Coly	Fine-silty, mixed (calcareous), mesic Typic Ustorthents
Dale	Fine-silty, mixed, thermic Pachic Haplustolls
Farnum	Fine-loamy, mixed, thermic Pachic Argiustolls
Harney	Fine, montmorillonitic, mesic Typic Argiustolls
Hedville	Loamy, mixed, mesic Lithic Haplustolls
Holdrege	Fine-silty, mixed, mesic Typic Argiustolls
Krier	Sandy, mixed thermic Aeric Halaquepts
Lancaster	Fine-loamy, mixed, mesic Udic Argiustolls
Lincoln	Sandy, mixed, thermic Typic Ustifluvents
Naron	Fine-loamy, mixed, thermic Udic Argiustolls
Ness	Fine, montmorillonitic, mesic Udic Pellusterts
New Cambria	Fine, montmorillonitic, mesic Cumulic Haplustolls
Owens	Clayey, mixed, thermic, shallow Typic Ustochrepts
Plevna	Coarse-loamy, mixed, thermic Fluvaquentic Haplaquolls
Pratt	Sandy, mixed, thermic Psammentic Haplustalfs
Quinlan	Loamy, mixed, thermic, shallow Typic Ustochrepts
Shellabarger	Fine-loamy, mixed, thermic Udic Argiustolls
Tivoli	Mixed, thermic Typic Ustipsamments
Tobin	Fine-silty, mixed, mesic Cumulic Haplustolls
Uly	Fine-silty, mixed, mesic Typic Haplustolls
Waldeck	Coarse-loamy, mixed, thermic Fluvaquentic Haplustolls
Woodward	Coarse-silty, mixed, thermic Typic Ustochrepts

INTERPRETIVE GROUPS

[Dashes indicate that the soil was not placed in the interpretive group]

Map symbol	Map unit	Land capability* N	Land capability* I	Prime farmland*	Range site
An	Albion sandy loam, 1 to 4 percent slopes	IIIe	IIIe	Yes	Sandy.
As	Albion-Shellabarger sandy loams, 4 to 15 percent slopes	VIe	---	No	Sandy.
At	Attica loamy fine sand, 1 to 4 percent slopes	IIIe	IIIe	No	Sandy.
Ax	Attica-Carwile complex, 0 to 4 percent slopes	IIIe	IIIe	No	Sandy.
Ca	Canadian fine sandy loam	IIe	IIe	Yes	Sandy Terrace.
Cc	Carwile fine sandy loam	IIw	IIw	No	Sandy.
Ce	Case clay loam, 2 to 7 percent slopes	IVe	---	Yes	Limy Upland.
Cf	Case clay loam, 7 to 15 percent slopes	VIe	---	No	Limy Upland.
Cg	Case-Canlon complex, 7 to 20 percent slopes	VIe	---	No	
	Case				Limy Upland.
	Canlon				Shallow Limy.
Ck	Clark loam, 1 to 3 percent slopes	IIIe	IIIe	Yes	Limy Upland.
Cm	Clark loam, 3 to 7 percent slopes	IVe	---	Yes	Limy Upland.
Co	Coly silt loam, 4 to 9 percent slopes	IVe	IVe	No	Limy Upland.
Cp	Coly silt loam, 20 to 40 percent slopes	VIIe	---	No	Loess Breaks.
Ct	Coly-Tobin silt loams, 0 to 20 percent slopes	VIe	---	No	
	Coly				Limy Upland.
	Tobin				Loamy Lowland.
Da	Dale silt loam	IIc	I	Yes	Loamy Terrace.
Fa	Farnum loam, 0 to 1 percent slopes	IIc	I	Yes	Loamy Upland.
Fb	Farnum loam, 1 to 3 percent slopes	IIe	IIe	Yes	Loamy Upland.
Ha	Harney silt loam, 0 to 1 percent slopes	IIc	I	Yes	Loamy Upland.
Hb	Harney silt loam, 1 to 3 percent slopes	IIe	IIe	Yes	Loamy Upland.
He	Hedville-Rock outcrop complex, 15 to 30 percent slopes	VIIs	---	No	
	Hedville				Shallow Sandstone.
	Rock outcrop.				
Ho	Holdrege silt loam, 0 to 1 percent slopes	IIc	I	Yes	Loamy Upland.
Hp	Holdrege silt loam, 1 to 3 percent slopes	IIe	IIe	Yes	Loamy Upland.
Kr	Krier sandy loam, occasionally flooded	VIs	---	No	Saline Subirrigated.
Lh	Lancaster-Hedville complex, 4 to 20 percent slopes	VIe	---	No	
	Lancaster				Loamy Upland.
	Hedville				Shallow Sandstone.
Ln	Lincoln sandy loam, occasionally flooded	VIw	---	No	Sandy Lowland.
Na	Naron fine sandy loam, 0 to 1 percent slopes	IIe	I	Yes	Sandy.
Nb	Naron fine sandy loam, 1 to 3 percent slopes	IIe	IIe	Yes	Sandy.

See footnote at end of table.

INTERPRETIVE GROUPS--Continued

Map symbol	Map unit	Land capability* N	Land capability* I	Prime farmland*	Range site
Ne	Ness silty clay	VIw	---	No	---
Nw	New Cambria silty clay	IIs	IIs	Yes	Clay Terrace.
Oe	Owens clay, 6 to 25 percent slopes	VIe	---	No	Blue Shale.
Pe	Plevna loam, frequently flooded	Vw	---	No	Subirrigated.
Pr	Pratt loamy fine sand, undulating	IIIe	IIIe	No	Sands.
Ps	Pratt loamy fine sand, rolling	IVe	IVe	No	Sands.
Pt	Pratt-Tivoli loamy fine sands, rolling	VIe	IVe	No	Sands.
Qw	Quinlan-Woodward loams, 6 to 25 percent slopes	VIe	---	No	
	Quinlan				Shallow Prairie.
	Woodward				Loamy Upland.
Sh	Shellabarger loam, 2 to 6 percent slopes	IIIe	IIIe	Yes	Sandy.
Th	Tivoli fine sand, hilly	VIIe	---	No	Choppy Sands.
To	Tobin silt loam, channeled	Vw	---	No	Loamy Lowland.
Ts	Tobin silt loam, occasionally flooded	IIw	IIw	Yes	Loamy Lowland.
Uc	Uly silt loam, 3 to 7 percent slopes	IIIe	IIIe	Yes	Loamy Upland.
Wa	Waldeck loam, occasionally flooded	IIIw	IIIw	Yes	Subirrigated.

* A soil complex is treated as a single management unit in the land capability classification and prime farmland columns. The N column is for nonirrigated soils; the I is for irrigated soils.

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